COAL AGE

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IT was a canny Scot who once remarked: "They can all seek glory by taking up with new contraptions. I myself want not glory, but profit, and I will only buy machinery and appliances of proved merit; let those who will, have the experience and the fame of being first in the field."—If we were all cast in that mold, we would still be digging the soil with a wooden spade.

But he who would give up the old beehive oven will get neither the glory nor the painful experience of the pioneer. He will enter into the fruit of other men's toils by an easy humdrum road. Even our canny Scot would feel inclined to venture, after about 38 plants had marked the way, and yet more if he knew that 5979 modern ovens were in operation in America at the close of 1910.

The coke producer when asked to make byproducts feels like the butcher who is urged to lay in a stock of groceries. It isn't in his line. But if he doesn't believe himself equipped to enter into such new extensions of his business, he can appreciate the fact that he can make more coke with a byproduct type of oven. The increase of yield lies from 7 to 10 per cent. New development should be figured conservatively. At $2.00 per ton for coke the 7 per cent. increase will show an additional annual profit of about $125 a year for each beehive oven that is replaced. Also, in considering the byproduct oven, you cannot overlook the fact that it can be levelled and drawn advantageously by machinery.

The surplus gas from a coal, which in a beehive oven would barely coke itself without the actual burning off of carbon, will be from 3000 to 4500 cu.ft. per short ton of coal. This gas on burning will generate over 600 B.t.u. per cu.ft. Taking conservative figures, the surplus heat from a ton of coal has an equal calorific value with 150 lb. of the same fuel burned to an ash. It is evident, therefore, that there is enough surplus heat to run, not only the byproduct plant, but the machinery of the mines also.

To face the issue squarely, the new ovens do not make such a "pretty" coke, because it is not quenched in the oven, and moreover it is not in such large lumps as the beehives have been making. However, the byproduct variety has strength, all necessary porosity, a slightly larger number of heat units, and does not lose so much from breakage as the beehive article. Besides, the modern ovens never have cold floors or damp backs.

So far we have not discussed byproduct ovens, but merely retorts without byproduct features. And perhaps it is better to end here, so as not to emphasize the departments of the business which the coke-maker regards as foreign to his industry. The man who studies coke manufacture is led inevitably, step by step, to the byproduct oven; first to the use of waste heat, then to the labor-saving retorts, and lastly to the formation of tar, fertilizer and ammonia, even if benzol, aniline and other coal-tar products do not necessarily follow.

Certainly the beehive is doomed. In the United States last year, the production of byproduct ovens rose 15 per cent. Concurrently the output of all other ovens fell 20 per cent. Will the independent coke producer make byproduct coke? He will or he will make no other. He cannot continue to meet the economies of his competitors without modernizing his plants. He cannot keep the furnace companies from making coke at cheaper rates than he can compete with by his unconservational conservatism.

At the close of 1911, 869 byproduct ovens were under construction while there were 1556 coke ovens of other makes being built. As a byproduct oven produces nearly four times as much coke as a beehive, the future of the industry is as clearly marked as is that of the navy by the building of super-dreadnaughts.

Were our canny Scot still living, he would be building byproduct ovens, not for glory but from fear.

Byproduct Ovens, Johnstown, Penn.

By R. D. Hall

The coal seams of Johnstown, being near the disturbance which elevated the Alleghenies, have been in part devolatilized and desulphurized by that action. At the plant of the Cambria Steel Co., the coal is coked in Otto-Hoffman coke ovens. This coke has proved most satisfactory and the plant has been continuously enlarged. The method of extracting byproducts and the interesting methods by which the coal is washed and handled are described.

Some loose generalizations are often made relative to the value of certain beds of coal for specific purposes. Some are said to be always unsuited for coking or to be low in fixed carbon. While a certain general character will mark any given coal seam, yet there are conditions which modify its character considerably, and location is one of these.

It would seem probable that all coal formed at any one time would have certain definite earmarks, for the vegetation, of which the originating peat bed was composed, was probably nearly uniform throughout the area of its deposition. The forests in the coal-bearing periods were nearly level. Differences in altitude and exposure to sun and wind make present-day vegetation extremely variant. But this variation could not have been so clearly marked then as it is now owing to the general dead level prevailing.

Coal beds were not laid down as a rule on unconformable strata and consequently the inorganic material, from which the food supply of the plant was derived, was nearly uniform. It is true, however, that lime strata are found thick in some places, thin in others and absent altogether in yet other places, but otherwise the unity of character in the underclay is remarkable.

Slight differences of elevation caused changes in thickness in the peat-bog, especially when those elevations were readjusted during deposition. The formation of small undulations in the surface of the coal beds also made a variation in the thickness and number of dirt partings. But the organic ash, the truly organic sulphur and the volatile matter were probably all alike over the whole extent of the bed.

Chances Occuring in Coal After Deposition

Moreover the early bacterial and chemical changes could not have been unlike throughout the whole field except where local erosions made it possible for solutions of iron to enter the coal and create pyritic compounds. Had the fuel beds then remained level, it is likely that the broadest generalizations regarding the nature of the coal found in a single seam might have been made with some show of accuracy. A standard formula would have covered the quality of coal found in one bed from one end of the field to the other, provided only that calculations were made of the coal constituents as reduced to a moisture-free, ash-free basis, the word "ash" being restricted to mean those bodies in the coal other than carbon, volatile matter and sulphur.

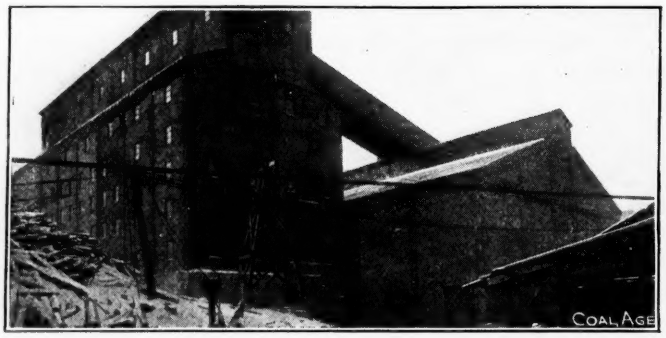
But along the crest of the Alleghenies, the coal was subjected to violent upheavals and crumpling. Folds 2000 feet high as measured from crest to trough marked that disturbance near Johnstown. The town lies in a broken syncline, known as the Johnstown trough. To the southeast lies the Ebensburg or Viaduct anticline, 1000 feet high, and to the northwest the Laurel Hill axis rears itself to an altitude 2050 feet above the Johnstown trough, the downward grades toward which average 19 per cent. for a distance of more than a mile.

This upheaval was accompanied by much heat and a large percentage of the volatile matter was driven off, including no little of the sulphur, which was then still doubtless uncombined with iron or calcium. The lower Kittanning bed is usually a coal with a large percentage of sulphur, but at South Fork, a town five miles southeast of the Johnstown syncline, the sulphur in the ash represents only 0.47 to 0.77 per cent. of the whole weight of the coal and even when Johnstown is reached the Kittanning coals are still lower in sulphur than coal from the same bed in parts further eastward, though they contain more of that impurity than is found at South Fork, Ehrenfeld and Winber. The volatile matter is also in low percentage.

The Sulphur in the Kittanning Bed

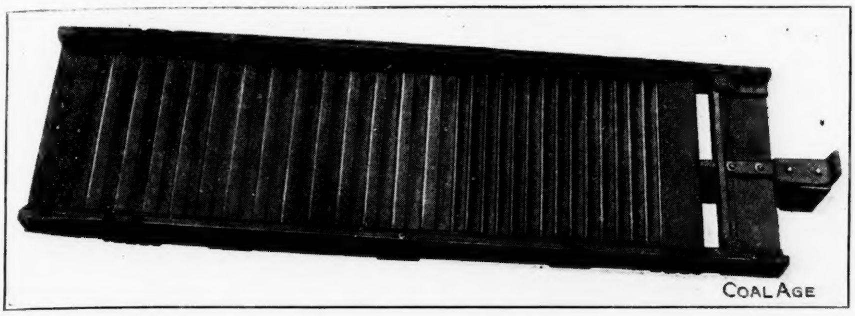
It is true that the analysis of the Johnstown coal in the lower and upper Kittanning beds as taken of the whole product and not cleaned, may show 3½ per cent. of sulphur. Selected pieces of coal of like horizon from the sections northwest of the Johnstown trough, may show less sulphur when analyzed, but in general a niche dug in the coal from roof to floor, not omitting binders under 1 in. thick, when quartered will show larger quantities of sulphur on analysis than most people are aware; as much as 6 or 8 per cent. There are only a few places where the lower Kittanning coal is being coked, many where it has been attempted and abandoned, none, I believe, where it is coked without washing. The slack alone is generally used for this purpose and the waste accompanying the washing is greater than could be for one moment considered by those who would use the whole mine product, large and small for coking purposes.

I would not be regarded as believing that proximity to an upheaval is the sole cause of low sulphur in any one given coal. The severity of the stress and the degree of heat thereby resulting is the more correct index, but it cannot be overlooked that there are parts of the same bed apparently equally stressed and, therefore, equally heated, which



Coal Washery and Storage House at Franklin Byproduct Plant, Johnstown, Penn.

No. 2 Condensing House with Ammonia Tanks for the Weak Liquor



COAL-WASHING CRADLE OF CAMPBELL TYPE AS USED AT FRANKLIN PLANT

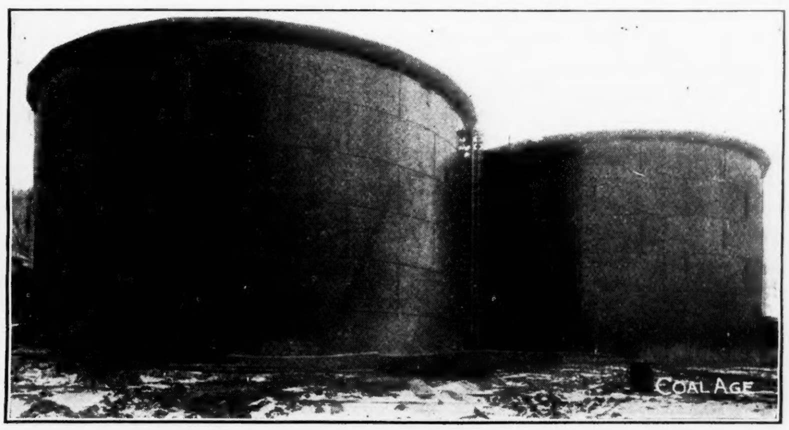
have important variations in sulphur content. Such variations we cannot well avoid attributing to one or more of three causes; lack of similarity in original vegetation, difference in later bacterial actions or the addition of inorganic sulphurous material during or after deposition.

THE CAMBRIA STEEL CO.'S MINES

The Cambria Steel Co. has four workings: The Rolling Mill mine in the "C prime," upper Kittanning or "cement" bed, Franklin No. 1 in the same bed, Franklin No. 2 in the "B," lower Kittanning or "Miller" bed and Conemaugh in the "E" or upper Freeport. The first and last mentioned mines produce coal for heating and general purposes. Yet it may be added that the coal from the Conemaugh mine is brought over in buckets to the Franklin tipple and there dumped, but the coal is not used with the Franklin coals for coking purposes.

The two Franklin workings are operated solely for the production of such coal as is intended for conversion into coke and byproducts. The upper Kittanning, which in many places is extremely irregular and often valueless, is here a highly reliable bed 48 in. in thickness. The lower Kittanning is about 49 in. thick and is reliable here as it is in every part of Pennsylvania but the lower Freeport coal is nowhere worked in this section. The Rolling Mill mine was opened in 1862 and 3010 acres are already extracted. The other mines are not such old operations.

INTERIOR NO. 2 CONDENSING HOUSE

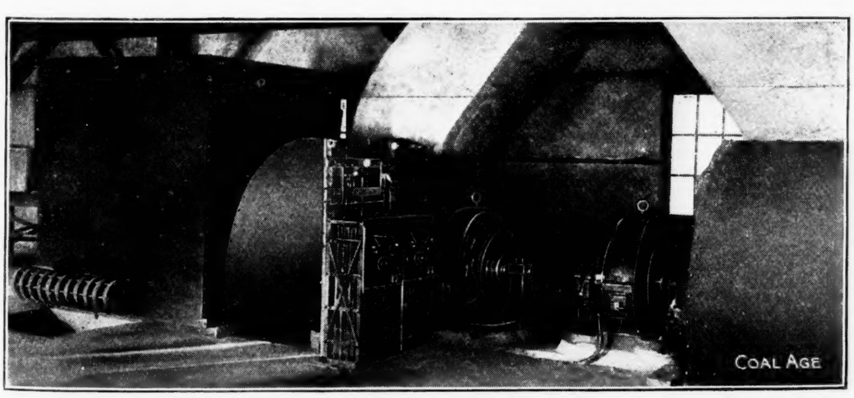


TAR-STORAGE AND SETTLING TANKS

COAL CRUSHING AND SEPARATING

All coal coming from the two Franklin mines is dumped and then elevated to a bin set over a Bradford patent coal breaker. The coal is delivered to the latter through a feeder which regulates the amount delivered in any given time. The breaker is a cylinder constructed of perforated steel plates. Adjustable cast-iron shelves are provided for raising the coal to such a height that it will break on falling and fingers regulate the advance of the coal. The broken material passes through one-inch perforations in the steel plates, while slate, sulphur balls, picks bolts and hard mine refuse are discharged at the refuse end of the machine.

The great advantage possessed by this coal breaker is that it protects the crusher rolls from being fed with material so hard as to act injuriously on them. Moreover, it reduces the work for the washers and sizes the coal for the final crushing. The breaker delivers the prepared material to the roll crushers, which machines crush the coal to a diameter of about 3/8 of an inch. This is the size which permits the undesirable element to be removed from the coal most economically. By means of a system of belt conveyors, the crushed coal is delivered from the breaker building to the supply bin over the washers. A belt conveyor with a traveling tripper directly above the supply bin serves to keep the coal equally distributed in this hopper.

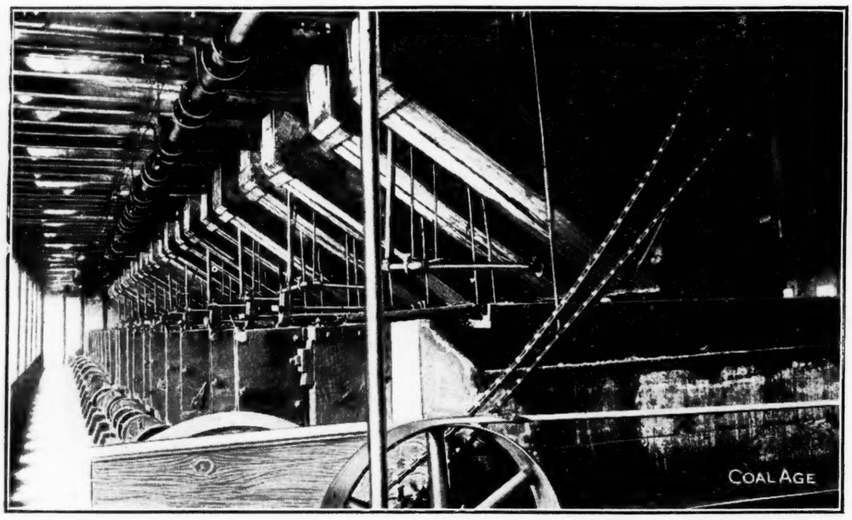


MACHINERY FOR HEATING AIR OF STORAGE HOUSE

A WASHER CONSTRUCTED LIKE A WASHBOARD

The crushed coal is delivered from the supply bin to the washer table by means of feeders and chutes, one for each washer table. In the chutes, the first water of the washing process is introduced and the crushed coal is thoroughly wetted before going to the washer table. The tables are arranged in pairs and each pair is mounted over a concrete washer box.

The washers are gently curved cradles, the bottom of each cradle having a surface like that of an ordinary wash board, but these corrugations are so constructed that the forward slope is gentle and the



A BATTERY OF CAMPBELL WASHERS

rear slope pitches straight downward. The last few corrugations are shaped like saw teeth and have small spaces between each corrugation. The table is operated by means of a cam which gives it a slow forward and a quick backward movement.

Bumping posts take up the impact of the table on the backward movement and the sudden stoppage creates speedy waves in the water passing over the table. Thus the coal in suspension is turned over, allowing the small refuse which would otherwise adhere to it to be separated. The slate after being discharged from the table is sluiced to the refuse pits in the storage building.

The particles of good coal in suspension pass continuously toward the forward end of the washer table, the action of the cam causing the coal to roll over and over and to travel some distance forward and a shorter distance backward until finally it is discharged in the washed-coal sluices leading to the pits prepared for its reception in the storage building.

Streams of water which can be regulated to the needs of the table are introduced to carry off the refuse material and to flush away the washed coal. The spaces between the last corrugations of the table were introduced for the purpose of removing the fine pyrites. After this impurity passes through those spaces it is carried away with the washer refuse.

The washer is very efficient and has a wide range of adjustment. Moreover, the work it is doing can be at any time observed without difficulty, because all parts are open for inspection. There are in all 84 washer tables at this plant and they are capable of washing, with efficiency, 4000 tons of coal per 10-hour day, or 4.8 tons per machine per hour.

WASHED COAL IS STORED ALMOST A WEEK

The coal storage house is of almost stupendous proportions. It contains five concrete coal bins, measuring 40x70 ft. and 25 ft. deep. Four other bins also of concrete and of like horizontal cross-section are 23 ft. in depth. There are two bins for the refuse from the washer, each of which holds 500 tons. The larger washed-coal bins will accommodate 1500 tons of washed slack, the smaller ones having a capacity of 1400 tons.

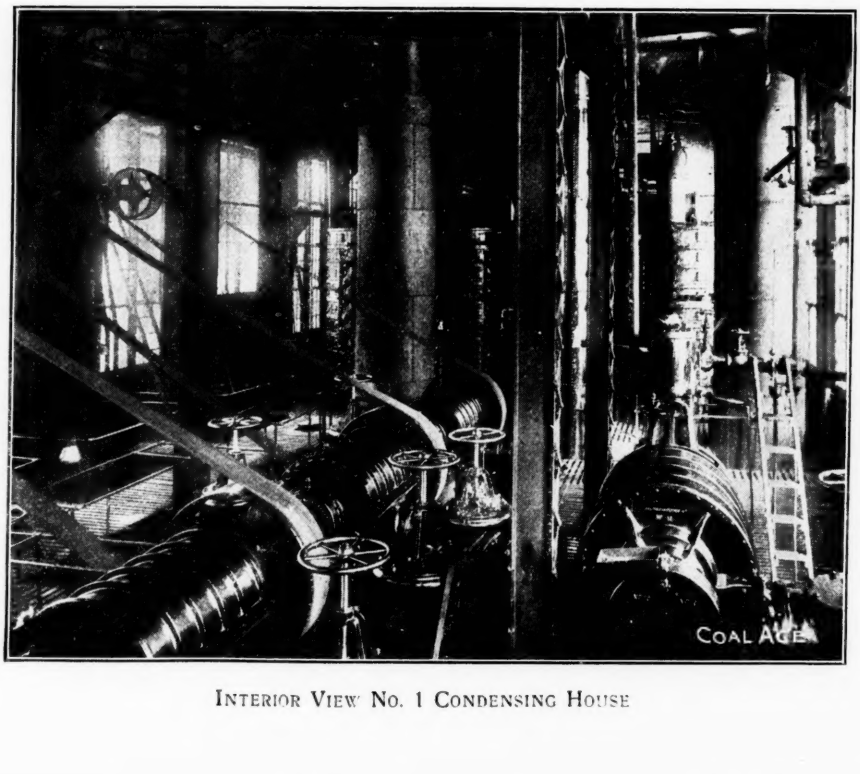
The coal is left in these bins for five or six days, during which time the water drains off, filtering through the underlying layers of coal, and returning to the water-pump pits to be used over again in the washing of other coal. The slats with which the bottoms of these tanks are covered, are omitted in the illustration which accompanies this article. But the main purpose of this drainage and drying of the coal is to reduce the waste of heat which would otherwise occur in the ovens. One hundred and twenty-three cubic feet of waste-product gas (running 500 B.t.u per cu.ft.) are consumed in the drying of a ton of coal for every unit per cent. of moisture in the slack. It is interesting to note that so far the sulphuric acid liberated by the coal has not appreciably injured the concrete of which the walls and floor of the bins are composed.

COAL REMOVED FROM BINS BY MOVABLE ELEVATORS

It is not customary to clean the bins completely more than once in two months. Some shoveling by hand is necessary when this is done, though the coal can nearly all be removed by the elevators provided for that purpose, and no hand labor is necessary, except to withdraw the last few tons of slack in the bottom of the pit.

On one side of the storage house, the coal and waste are flushed in, the same water which has carried the material from the washer-house serving to distribute the slack throughout the full length of the house. Gates are provided opposite every bin and two movable sluices run on a rail along the edges of the bins. These sluice-ways are moved backward and forward by portable cranes, mention of which is now timely.

Two large traveling cranes run over the bins and rest on heavy rails set on opposite sides of the building, level with the floor. The frames of these cranes are large, as may be imagined when it is stated that the framework extends 39 ft. above the rail on which the mechanism travels.

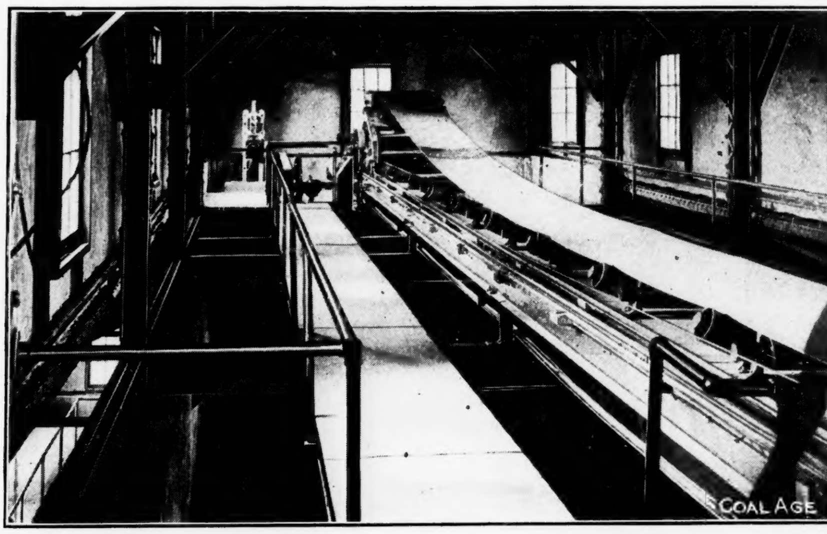


INTERIOR VIEW NO. 1 CONDENSING HOUSE

On the deck of each crane are the motors which operate it, a track along which and a mechanism by which a rubber belt for conveying washed slack is moved transversely across the bins, and also mechanism by which the crane is moved forward along the storage house. And in addition, an extensible bucket elevator is provided by which coal is taken from the bins, elevated and dropped onto the moving rubber belt, before mentioned, and carried to the discharging side of the storage house.

The bucket elevator traces in its motion the outer lines of the shape of the letter "T," the base of the letter being represented by the sprocket which is lowered into the bin and the point of dumping being under the right limb of the letter. In order to permit the extension, the part of the flight represented by the left limb of the "T" is provided with an adjustable sprocket, which descends and increases the length of that part of its travel in proportion to any decreased travel in entering the bin.

The digging end of the elevator is provided with two multipoint-star cutting wheels, which revolve on either side of the lower sprocket and thus break up any masses of slack which have tended to adhere to each other and which make the passage of the buckets difficult. But the adherence is not noticeable and the side wheels could be dispensed with. The elevators dig, of course, only when the carriage is traveling in one direction, which is in this case toward the discharging side of the storage house. On reaching the far side of the building, the slack dumps onto a 22-in. rubber belt, and is carried to a conveyor by which it is transferred to the larry bin near the coke ovens.

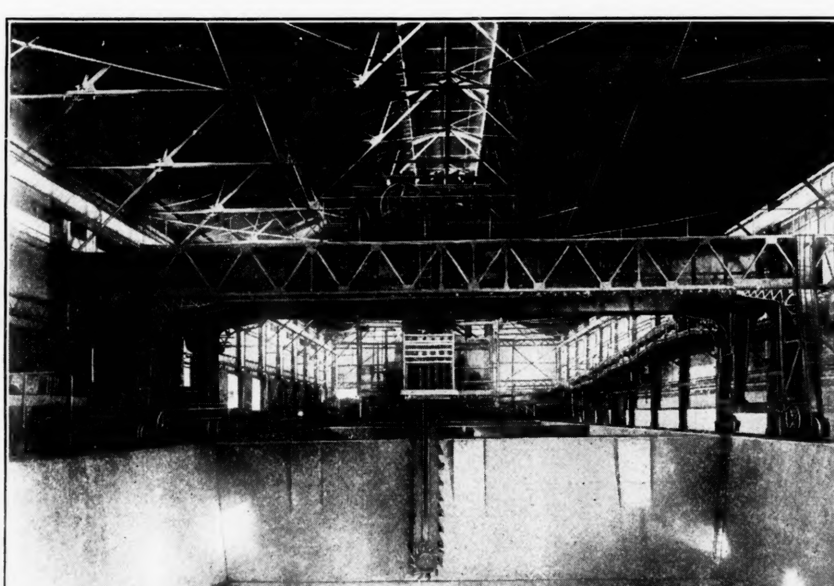


Belt Conveyor to Distribute Coal in Bins over Washer

The washer and storage plants were planned and installed complete by Heyl & Patterson, contracting engineers, Pittsburgh, Penn.

Heating System for Winter Months

The storage house is kept warm by air, which is heated by drawing it through steam coils. To draw the air through these, two B. F. Sturtevant fans are provided. Two large conduits of galvanized-iron pipe distribute the air along either side of the house and smaller take-off conduits bring the air down within about 5 ft. of the tops of the bins. The air is there released and it does its work satisfactorily without further constraint or direction.



Heyl & Patterson Traveling Elevator Crane with Draining Pit

The purpose of this heating is not to dry the slack; drainage, natural heat and the heat generated by the coal are relied on to do this. The heating system is only used during the winter and its purpose is solely to prevent the freezing of the bins. About 8½ per cent. of water remains in the coal on delivery to the ovens. Everything in the storage house is of the most solid construction, the buildings being of steel and concrete and the bins of concrete. When full, the storage house will hold 13,100 tons of washed coal and 1000 tons of waste.

The Otto-Hoffman Ovens

The Otto-Hoffman oven is a mere slit in a wall. It is only 15 in. wide at one end and 19 in. at the other, the divergence of the sides, of course, being for the purpose of aiding in the pushing out of the charge. The oven is 32 ft. 8 in. long and the charge stands 6 ft. deep, an 8-in. air space above the coal serving to permit of the introduction of the leveler over the top of the charge.

Such a mass of coal, coked from the two walls instead of from top to bottom, does not have any opportunity to expand. The walls have to withstand the tendency of this coke to increase in bulk when forming its cells. Thus coked within confining limits, the cell space formed is only that provided by the loss of volatile matter, which indeed is not all lost to the coke, for some of it is deposited in typical masses of dull metallic luster on the faces of the vesicular carbon.

The coke is, therefore, denser than that made in beehive ovens, and this has created a prejudice against it, as indeed against all byproduct coke—a prejudice which is fast disappearing, as experience is showing that with proper use a lighter coke with more cell space is not needed. There are sufficient opportunities for the heat and air to reach the coke throughout its substance; consequently there is no need for more. Coke responds immediately and burns in every part of the

body without loss of shape. The objection to anthracite, that the air can only reach the heart of each lump by its decrepitation, does not hold true for even the densest of cokes.

Size of Coke

As the coking commences at the walls and proceeds toward the center of the narrow oven, there is a plane where the coke from one wall meets the coke from the other. This is a plane of fracture in the completed coke mass. As the oven is only 15 in. wide at one end and 19 in. at the other, the coke tends to be from 7½ to 9½ in. long, but it often breaks up finer than this.

The coal is charged by a large larry which spans across the ovens. Small openings are provided in the tops of the retorts for that purpose. As the coking chambers are long and narrow, four charging ports are necessary. The previous charge having been pushed out unquenched and the passage of heat through the flues on either side continuing unchecked, the oven is at a white heat when it receives its charge. Coking of the dry slack commences at once.

In so short a space of time as 22 to 24 hours, the charge is completely coked and ready for pushing. Some of the ovens of the Cambria Steel Co., it may be here said, are 17 in. wide, enlarging to 21 in. at the quenching end. These larger ovens take 25 hours to coke.

Combustion Flues Maintain Heat of Ovens

While the ovens pass continuously across the full width of an oven block, the narrow combustion chambers or flues are not so arranged. They are divided by a narrow partition wall, into two parts. The air, heated by passing through a regenerating checker-work of brick, enters below the oven floor and passes out by a series of small ports to the combustion chamber or flue on either side of the oven. Here it meets the washed and scrubbed gases and enables them to burn The products pass into the flue at the rear, situated as before described. From thence they pass to another regenerator, give out most of their remaining heat and are permitted to escape.

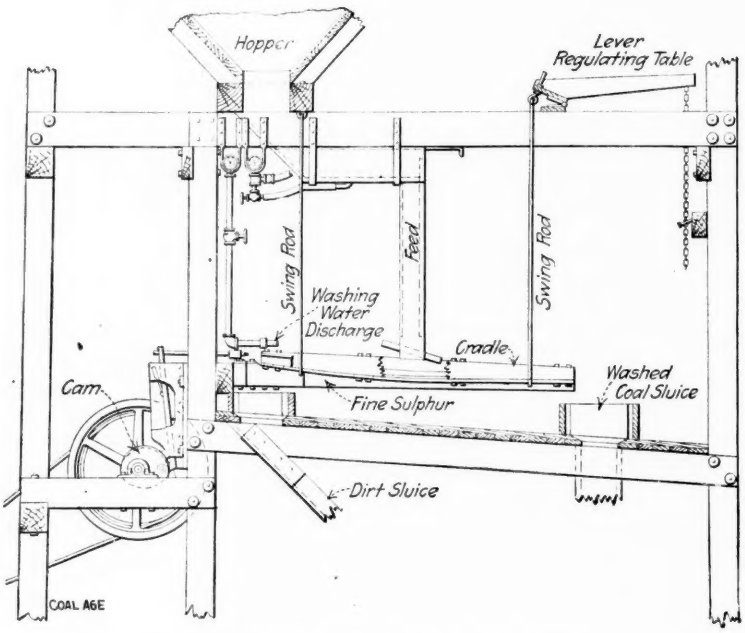
About every hour, the process is reversed and the regenerator which has been storing heat now gives it up to the entering air, while the end of the oven which has been subjected only to the heat of the escaping burned gases is now heated by the intense heat of gas in process of combustion. Thus not only is the heat of the burning gases almost entirely saved, but its intensity is equally divided between the two ends of the oven.

How the Tar Is Saved

The gases from the coking of the coal are removed from the tops of the ovens. The resistance resulting from passing them through the pipes, the cooler and the scrubber is overcome by creating a vacuum by means of exhausters. The gases are cooled in a series of stand-pipe coolers, around which water is allowed to play. This causes most of the tar to be deposited, but in order to make a completer extraction, the gases are passed through a scrubber. In rising through this tank they are compelled to pass through water traps and the cooling and mechanical action of the water disengages all the remaining tar.

The temperature is, however, so high that but little ammonia is absorbed by adsorbed by one volume of water; at 77 deg. F. the ability to retain ammonia has fallen nearly 50 per cent., so that 610.8 volumes of ammonia suffice to saturate one volume of water. This is why the temperature at which condensation takes place is so important.

The gas leaves the ammonia house and returns to be burned in the oven flues, while the ammonia liquor is pumped to the stills for concentration. Before this is done, the liquor is treated with lime. Lime combines with sulphates and chlorides of ammonia, replacing the ammonia and forming sulphates and chlorides of calcium. No use is made of this product, but the ammonia saved



The Campbell Washer with Attachments

this operation. The tar secured here and in the cooling towers is utilized in various ways; among others, for roofing purposes, and for the creation and maintenance of self-draining surfaces on country and suburban roads. There does not seem any difficulty in finding a good market for the product, though in foreign countries there is much complaint about the impossibility of disposing of the large quantity of tarry wastes.

The Formation of Ammonia Liquor

After passing the scrubber, the gases are compressed and as this compression, though small (usually equivalent to 30 in. of water gage), raises their temperature, they must be cooled. They then pass to the washers, where the ammonia is washed down by water. The temperature is low enough by this time to permit the ammonia to combine with the water freely. At the freezing point of water, 1174.6 volumes of ammonia are adsorbed by one volume of water; at 77 deg. F. ...

adds considerably to the output of the plant.

Making Fertilizer

The concentrator consists of two parts. In one, steam is compelled to pass by a devious course through the weak ammoniacal liquor. It continually drives off the ammonia in its passage through the liquor and then passes on to a condenser, which is built on the plan of a vertical multitube boiler, cold water being passed through the tubes and the vapor passing around the same.

This steam is condensed to moisture, and the ammonia adsorbed by the water. This gives a liquor which runs 17 per cent. by weight ammonia. When it is desired to make sulphate of ammonia, the steam and ammoniacal vapors are taken to a lead-lined saturator containing dilute sulphuric acid. The sulphate thus formed is freed from water by centrifugal action in a revolving close-mesh basket. It is then bagged and shipped to serve as a valuable constituent of ferti-

lizer mixtures. The wholesale price of this product is about $60 per ton.

The question naturally arises, does all this elaborate saving of byproducts pay? The answer is well furnished by the action of the Cambria Steel Co. It installed only 60 ovens at first, later it added 100 more, then another 100 and finally 112. If the ovens had not been profitable, the steel company would not have persistently added to their number.

CHEMISTRY OF WASHING

Analyses are taken every day of the coal, washed coal and coke, but the samples are not taken from the coal as it leaves the mine, but as it emerges from the Bradford breaker. This machine lowers the sulphur content in the whole coal nearly 1 per cent., so its purifying action must not be overlooked. The following analyses are representative, being the averages of nearly 200 examinations.

ANALYSES OF CONVERSION OF COAL TO COKE
CAMBRIA STEEL COMPANY

	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulphur in Ash
Unwashed coal....	0.48	17.02	70.94	11.55	2.39
Washed coal....	0.34	17.52	74.59	7.54	1.31
Coke.....	..	1.18	89.35	9.47	0.89

A New Direct Byproduct Process

Special Correspondence

A description of the Simon-Carves direct byproduct recovery process, an entirely new and logical solution of this problem. By this method advantage is taken of the higher specific gravity of the coal tars which are deposited by means of a rapid centrifugal action, thus eliminating the necessity of cooling and reheating the gases. A more effective separation and a greater economy in operation are some of the advantages claimed for the process.

Note—Abstract of paper appearing in the "Iron and Coal Trades Review," London, England, Jan. 19, 1912.

The improvements that have been introduced into the process of byproduct recovery in connection with coke oven installations have invested the subject with an interest and importance that justify extended notice. Before proceeding to a descriptive account, however, of the special process which is the subject of this article, a brief retrospective survey of the growth and development of the byproduct recovery system may prove acceptable.

A Review of the Present Methods

Until quite recently the method of byproducts recovery in connection with coke ovens was similar to that adopted years ago, and still almost universally used, by the gas industry. The hot gases from the distilling chambers were cooled down to atmospheric temperature in order to condense the tars; the aqueous vapors also present were deposited at the same time, retaining part of the ammonia contained in the gas. This condensed liquor was used together with fresh water to wash the remaining ammonia out of the gas. From the strong liquor thus obtained the ammonia was finally recovered by distallation and generally used for the manufacture of ammonium sulphate.

Coke-oven engineers worked for years on these well-approved lines, steadily perfecting this indirect process in designing thoroughly efficient plants yielding highly satisfactory results. It was realized, however, that to cool down the gases in order to condense the aqueous vapors containing ammonia, and afterwards to reheat the condensed vapors to recover the ammonia, was the reverse of heat economy. Attempts were therefore made to discover a more economical process, in which the waste of heat entailed by those two intermediary operations should be avoided, the ammonium sulphate being manufactured direct from the ammonia contained in the hot gas.

New Process Tried

The first to attack the problem of "direct" absorption was Brunck, who in 1903 sought to pass the hot uncondensed gases from his coke ovens through sulphuric acid. The process failed at the time, because the gases were still contaminated with tar when they reached the saturator, dirty unsalable sulphate being the result. Brunck's experiments showed that to make a direct process successful, means must be found to remove all traces of tar from the gases before they entered the saturator. The problem of tar extraction from hot gases, was, however, a difficult one, and several years elapsed before it was solved.

Meanwhile, other processes were devised in which the gases were passed through sulphuric acid after having been previously cooled down, and sometimes reheated. Promoters of such systems contend that they have solved the problem of direct ammonia absorption. Messrs. Simon-Carves state that, in their opinion, these processes are only "semi-direct," and differ very little from the indirect system, on the ground that they do not dispense with the ordinary condensing plant, and the expense entailed by the cooling of the gas. The condensed liquor has to be treated in the usual way in an ammonia still. On the other hand, no fresh water being used for the washing of the gas, the quantity of efficient liquor from the sulphate house is reduced.

Messrs. Simon-Carves claim that such systems have not advanced very far in making the process of ammonia recovery more economical owing to the cooling of the gas and subsequent distillation of the liquor remaining an essential feature, the cost of which is only slightly reduced. Their view is that double saving of heat and labor which was aimed at in the manufacture of ammonium sulphate can only be effected by the adoption of a truly direct process that is, a process in which the hot gases previously freed from tar are passed through the saturator before they have reached the dew point, or temperature at which the condensation of the water vapors contained in the gas begins to take place.

One of the drawbacks to the direct process has been due to the method of tar extraction not being perfect. This method was found to possess two fundamental drawbacks. (1) It necessitated the use of powerful pumps to spray the tar under high pressure into the gas, and consequently a large portion of the steam saved through the recovery of the ammonia was needed to work the tar-extracting apparatus. (2) In spite of its heavy consumption of power the tar spraying was not always effectual in removing all the tar from the gas, its efficiency depending to a great extent on the nature of the coal and its yield of tar. In cases where the extraction of the tar was not complete, the tar oils which were carried forward into the saturator had the effect of discoloring the sulphate produced, thereby reducing its value.

The Simon-Carves Method

In the process now to be reviewed the makers claim to have succeeded in perfecting a method of tar-extraction which obviates the drawbacks of other methods, and realizes all the conditions required to make the application of the direct-recovery system successful.

The special features claimed for the Simon-Carves "direct" system are: (1) Simplicity of design; (2) minimum steam consumption and working costs; and (3) perfectly white sulphate.

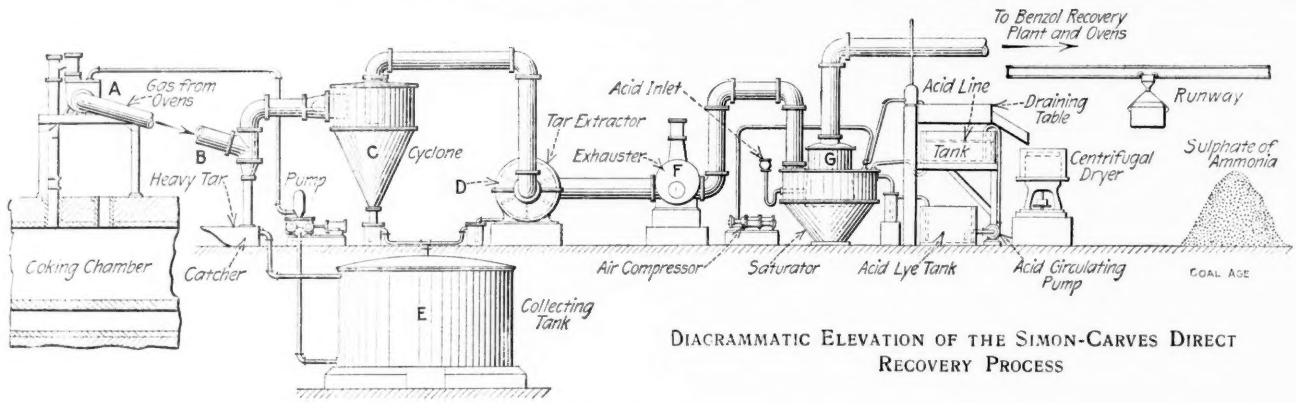
Referring to the accompanying diagrammatic illustration, the process is briefly as follows: The gases from the

ovens, collected in the hydraulic main A, are led through the foul gas main B into the extractor or cyclone C. From there the gases pass through the dynamic extractor D, the tars from both extractors being collected in the collecting tank E. The gases, which are then free from all traces of tar, are forced by the exhauster F through the acid seal of the saturator G, the ammonia in the gas combining with the sulphuric acid and forming ammonium sulphate.

After leaving the saturator, the gases, which are still hot, are returned to the ovens and burnt in the heating flues. During the whole process the temperature of the gas does not fall below the dew point, so that no condensation of the water vapors takes place. In cases where the cooling surface of the plant is too great, part of the gas main is covered with non-conducting material. In order to resulting centrifugal action is much greater in the case of the tar drops than in that of the surrounding gas owing to their higher specific gravity. The tar drops are therefore thrown to the periphery of the centrifugal separator, where they coagulate, and can be drained away.

It has been found that the drops above a certain size formed by the denser tars can be separated from the gas at a relatively low velocity, whereas the separation of the very fine drops formed by the lighter tars can only be effected by means of a very intense centrifugal action. This points to a fractional separation as being the most rational, and such has been adopted by Simon-Carves, Limited, who find such a separation to give the best results in practice, and to conduce to the highest efficiency and greatest saving of power. Their tar extracting plant, which is compact and simple in design, and costs nil; (2) owing to the design the amount of power it absorbs to impart a rotary motion to the gas is so small as to be negligible; (3) it requires practically no supervision, and no labor in connection with its working; (4) it does not need by-passing, nor duplication to ensure continuous working. Any deposit of thick tar or pitchy matters inside the apparatus can be washed down by pumping tar through it.

In the dynamic separator used in the process a rapid rotary motion is imparted to the gas by means of vanes of special construction revolving at a peripheral speed of over 200 ft. per second. The fine drops of tar still contained in suspension in the gas after passing the cyclone are thrown on to the periphery of the separator, and being brought into violent contact with one another, combine into larger drops, which collect in the



Diagrammatic Elevation of the Simon-Carves Direct Recovery Process

ensure continuous working, the final tar extractor and the saturator are duplicated. The whole of the recovery plant, with the exception of the cyclone, which requires no attention, is contained inside one building. The pump shown towards the left of the plant is for circulating a small quantity of tar through the hydraulic and foul gas mains and through the extracting plant to keep the pipes and apparatus clean.

The Centrifugal Extractor

The tars are extracted from the gas by means of centrifugal force and in two stages: the removal of the heavier and denser tars is effected in a centrifugal separator of the cyclone type without any moving part; the lighter and more fluid tarry matters still contained in the gas are then separated at a high velocity in a dynamic centrifugal separator. At the temperature at which the gas is treated in the tar extracting plant, the tar vapors have condensed into very small drops which are carried in suspension in the gas.

The size of these drops varies with the specific gravity of the tars, the heavier tar oils forming the larger drops. When a gyratory motion is imparted to the gas in a centrifugal extracting apparatus, the little to work, has proved successful with all classes of coal, including some of the richest Yorkshire coking coal.

The cyclone tar separator is so designed that the action of the exhauster imparts a rotary motion which is maintained without the aid of any moving parts until it leaves the apparatus. The gas enters the upper portion of the cyclone, which is cylindrical, through a tangential inlet at a velocity regulated by a valve of special construction. The conical shape of the lower portion of the cyclone counteracts the gradually diminishing velocity of the gas as it proceeds towards the bottom, so that in a well-proportioned apparatus the centrifugal action is fully maintained. The gas leaves the apparatus through a central outlet pipe which extends a certain distance below the top cover, so as to prevent any interference with the cyclonic action. The tar which is separated from the gas by the centrifugal force developed collects at the bottom of the inverted cone and flows out through a sealed drain pipe.

Advantages of This Method

The advantages claimed for this cyclone system are: (1) The cyclone containing no moving parts, its working entails no wear and tear, and the cost of upkeep is lower portion of the apparatus and are drained out.

The advantages of these dynamic separators may be summed up as follows: (1) Very little motive power is required to drive them, amounting to about 1 hp. per 12,000 cu. ft. of gas per hour; (2) the gas is freed from all traces of tar, with the result that the sulphate is free from all impurities, perfectly white in color, and such as to command the highest market price; (3) as the gas entering the separator does not contain hard pitchy matters and thick tars rich in free carbon, but only fluid tar oils, the wear and tear of the blades is insignificant in spite of their high speed, and the cost of upkeep is small; (4) the separator requires little supervision, and is easily attended to by the man in charge of the exhauster and saturator.

In the direct recovery process a saturator, especially constructed to suit the requirements of direct absorption, is the only apparatus required for the manufacture of ammonium sulphate. As in the ordinary sulphate plants, the saturator is duplicated to ensure continuous working. The rest of the plant, *i.e.*, the draining tables, centrifugal drying machine and sulphate store, is designed on lines similar to those adopted by Messrs

Simon-Carves, in their modern sulphate plants working on the ordinary system, and is such as to reduce the necessary labor to a minimum. The advantages claimed for "direct" recovery are:

(1) The process effects a substantial saving in ground space and apparatus It dispenses with the condensing and scrubbing plant, the cooling water and liquor circulating pumps, and the tanks for the decantation and storage of the liquor, which are required with other systems. No ammoniacal liquor being formed during the process, the ammonia stills, liquor superheaters, lime mixing and pumping machinery and lime settling plants are dispensed with.

(2) The process also effects a saving in labor and upkeep, owing to the simplicity of the plant, its compactness, and the small amount of machinery required. The temperature of the acid bath in the saturator is much lower in this process than in the ordinary process, and this tends to reduce the wear and tear of the leadwork.

(3) A saving in water is effected and the necessity for cooling and scrubbing water is dispensed with.

(4) As practically all pumping machinery and ammonia stills are dispensed with the saving in steam is important. At least 8 tons of steam are consumed in the other processes per ton of sulphate manufactured. This is entirely saved in the direct process, the heat generated by the exothermic reaction between the ammonia contained in the gas and the sulphuric acid being sufficient to prevent any condensation of steam in the saturator and to evaporate the waste present in the acid.

(5) No lime is needed in connection with the manufacture of the ammonium sulphate.

(6) The production of waste liquor and other deleterious effluent is avoided.

(7) A higher yield of ammonia is obtained from the same coal by the direct process than by the indirect or semi-direct systems, as it avoids the loss of ammonia in the waste liquor and the loss by evaporation resulting from the storing and manipulation of ammoniacal liquors.

(8) The ammonium chloride contained in the gas can be isolated at a low cost and additional profit thereby realized, the market price of ammonium chloride being approximately 30 per cent. higher than that of ammonium sulphate for the same ammonia content. Wherever it is found advisable to recover chloride, a small quantity of liquor is allowed to condense in the dynamic separator, which washes the chloride out of the gas. On concentrating the solution thus obtained a marketable chloride of ammonia is produced. The quantity of liquor thus condensed can be regulated, so as to reduce the cost of evaporation to a minimum.

Whenever it is desired to recover the benzol in the gas or to use some of the gas in gas engines or for lighting, the whole or a portion of the gas must be cooled down after it has left the ammonia recovery plant. In such cases the liquor is condensed out of the gas and has to be disposed of. As, however, it does not contain any ammonia and lime salts, nor any solids in suspension, and is altogether of much milder nature than the ordinary waste liquor from stills, it can be used without detrimental effect either for coke quenching or coal washing.

Water and Moisture Absorption by Coke

In addition to experiments which have already been published in this journal on the absorbent power of cold coke in hot water and incandescent coke in cold water, I have continued these investigations by determining the absorbent power of coke in cold water after short intervals of time. While in the earlier published tests the coke used was in small fragments (sizes 1.2 to 1.6 in.) larger pieces, such as are adapted for charging foundry cupolas, were used on these later tests. The experiments were conducted with coke samples from two neighboring coke plants.

For determining its water-absorbing power, the trial coke was first thoroughly dried, then accurately weighed, immersed in cold water and re-weighed after the periods of time stated in Table 1. The water absorbed is expressed in percentages, the tests being in triplicate.

There are also experiments showing the hygroscopic property of the coke. Thoroughly dried coke of about the size of a man's fist was placed in a moist chamber, and the water absorption determined after the intervals stated in Table 2. The moist chamber was formed by a wooden box of about 35 cu. ft. capacity, having a false bottom. Into this box cold steam was slowly run, so that the air of the chamber was soon impregnated with moisture. In order to have a measure for the humidity, the absorption of water, by calcium chloride was also determined, and the results obtained are given for comparision. These results, together with those for the coke, are clearly shown in Table 2.

TABLE I. WATER ABSORPTION OF COKE IN COLD WATER

Time tne Pieces of of Coke Remained in the Water	Coke Works I. Water Absorption				Coke Works II. Water Absorption			
	Test				Test			
	I %	II %	III %	Mean %	I %	II %	III %	Mean %
¼ Hour	6.1	6.1	6.4	6.20	4.9	2.9	4.2	4.2
½ "	6.4	7.7	7.6	7.23	5.2	3.8	4.8	4.6
1 "	6.8	8.1	8.4	7.7	5.6	4.2	5.2	5.2
2 "	7.8	9.2	10.4	9.1	7.7	5.5	6.6	6.6
3 "	8.8	9.9	11.7	10.1	9.1	6.7	7.3	7.7
6 "	9.9	10.9	12.9	11.2	9.9	7.9	8.4	8.7
12 "	11.8	12.9	14.0	12.9	11.3	9.0	9.5	9.9
24 "	13.2	13.9	15.1	14.1	12.1	10.1	10.6	10.9
2 Days	15.6	15.9	16.4	15.9	13.5	11.6	12.1	12.4
3 "	16.9	17.4	17.3	17.2	14.5	12.6	13.3	13.5
4 "	16.9	17.4	17.3	17.2	14.6	12.6	13.3	13.5
5 "	17.0	17.6	17.3	17.3	14.7	12.6	13.5	13.6
6 "	17.0	17.6	17.3	17.3	14.7	12.7	13.5	13.6

TABLE II. WATER ABSORPTION OF COKE IN MOIST AIR.

Time the Pieces of Coke Remained in Moist Air	Coke Works I Water Absorption				Coke Works II. Water Absorption				Calcium Chloride Absorbed in the Same Time. Water in Percentage of Weight
	Test				Test				
	I %	II %	III %	Mean %	I %	II %	III %	Mean %	%
6 Hours	0.04	0.01	0.02	0.02	0.06	0.05	0.06	0.06	15.2
12 "	0.04	0.02	0.02	0.03	0.08	0.07	0.08	0.08	18.8
18 "	0.04	0.02	0.02	0.03	0.12	0.08	0.09	0.10	29.6
24 "	0.04	0.04	0.02	0.03	0.14	0.10	0.08	0.08	38.8
2 Days	0.11	0.05	0.06	0.07	0.27	0.19	0.14	0.20	49.8
3 "	0.11	0.05	0.06	0.07	0.27	0.19	0.14	0.20	59.1
4 "	0.11	0.06	0.08	0.08	0.27	0.20	0.19	0.21	66.6
5 "	0.12	0.07	0.08	0.09	0.28	0.24	0.21	0.24	74.2

From the experiments in Table 1 it appears that the maximum absorption of the large size coke in cold water was not reached until after three days, after which time the increase became very slight. The hygroscopic capacity, or water absorption from moist air, was reached within the fifth day.

The first of these experiments, compared with those published earlier, show that in estimating the water contained in coke, a great deal of judgment must be exercised to insure correct results.

Note—A report from a Coke Works Laboratory, translated from "Stahl und Eisen, June 13, 1912.

Life of the Connellsville Region

The accompanying co-ordinated diagram shows the increase in coke production in the Connellsville region and in the United States and on it is drawn for comparison, a line, showing what the increase of coke production will be if the output mounts by a yearly increment of five per cent. During the past twenty years however the average increase in coke production has been nearer seven per cent. than five.

PRODUCTION OF CONNELLSVILLE REGION

Period from	to	Coke Tonnage
1881	1890	41,200,562
1891	1900	70,677,393
1901	1910	156,621,873

The tonnage in the last ten years exceeds that of the entire previous life of the Connellsville Region and with the present capacity as a base and with an increase per annum placed at 5 per cent., there will not be an acre of Connellsville coking coal remaining in either of the Connellsville regions in 1930. The total depletion up to that year will approximate 126,000 acres of coal or 88,000 acres from 1910 to 1930. The area remaining in 1910 in the Upper and Lower Regions was about 90,000 acres.

100 Ovens Deplete 9 Acres Per Year

Estimating that 100 ovens working at full time at their present capacity consume the coal content of nine acres, 73 coke plants will have exhausted their present available acreages in eight years. These plants are all in the Connellsville and Lower Connellsville regions and the fact furnishes significant evidence of the rapid depletion of the coking-coal resources of the great coke-making center of America.

The 23,000 ovens of the Connellsville region will have exhausted the remaining 33,000 acres of coal in slightly over 16 years. Other conditions will tend to decrease this period of time, such as improper mining and loss through falls and fires.

In the Lower Connellsville region, 58 of the coke plants will be out of acreage within 20 years at the present rate of production and it is this region, where there are many plants with large acreages and a comparatively small number of ovens, which will have to be depended upon to keep up the tonnage.

After a period of eight or ten years, estimating that an increase of 5 per cent. per annum in coke production will take place, many thousand ovens will have to be built each year in order to take care of the increase, and this would shorten the life of the Lower Connellsville region causing the entire acreage to be depleted within less than 20 years.

The life of the Lower Connellsville region, grouping the corporation interests, independents and independent furnace interests, taken as a unit would be approximately 40 years, all plants working full and allowing 100 acres per annum for mines shipping coal to outside points. But it is in this region that the increase in the number of ovens will be made to take care of the future production, including the normal increase, and even then Greene and Washington counties on the east will have to be invaded in the very near future in order to meet certain demands which will require increased tonnages of coke.

Thus it is impossible to disregard the effect of the early depletion of the Connellsville field proper upon the Lower Connellsville region. Its exhaustion will be rapid when the support of the older field is withdrawn.

By John W. Boileau*

The Connellsville coke region will be exhausted by the year 1930 if the present output increases only 5 per cent per annum. Seventy-eight coke plants have only eight years of life remaining. Depletion of the other areas will become more rapid as the support of these plants is withdrawn.

Note — Quoted from Connellsville Courier.

*Consulting Engineer, 607 Park Building, Pittsburgh, Penn.

Connellsville Coke is Near Market

To understand how near these fields are to the large centers of consumption we need only to analyze the situation as follows: There are 480 blast furnaces in the United States. Ohio and Pennsylvania have 242 of these, and, because of the larger capacity of the furnaces of these two states they have a capacity of 24,000,000 tons of iron, while the whole capacity of the United States is 40,000,000 tons. The coke requirement of the two states is 20,000,000 tons annually.

In the Pittsburgh district there are 52 stacks which require 7,625,500 tons of coke annually. In the Youngstown district, Mahoning and Shenango valleys, there are 43 stacks requiring 4,800,000 tons of coke annually; while at Wheeling there are 14 consuming 1,543,000 tons of coke yearly. Over in Johnstown, Cambria and Indiana county districts, there are 8 stacks using 910,000 tons of coke annually. At Cleveland, there are 8 demanding 1,087,000 tons of coke every year. In eastern Pennsylvania, in the Harrisburg, Cornwall, Reading, Bethle-

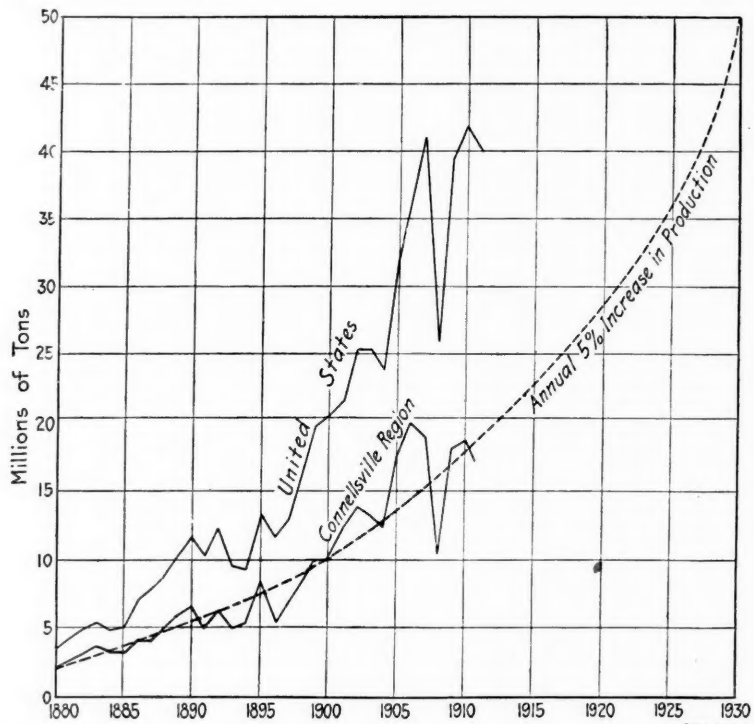


Diagram Illustrating Probable Future and Actual Past Coke Production of the Connellsville Region and Past Output of the United States

hem and Philadelphia districts there are 53 stacks which utilize more than 3,500,000 tons of coke every twelve months. Some of these furnaces are comparatively small.

Owing to the centralized position of the Connellsville field it seems as if the stability and supremacy of Connellsville coke is assured providing that fair treatment is accorded the coke operators. As an investment the manufacture of coke should be safe. The coal in the hill is indestructible; it should not be given away as has been the case in the past two or three years. Its continued use is just as certain as the fact that our great industrial progress is bound to continue.

The ore people during the past few years have been receiving a fair margin of profit upon their product and it is time that the coke people were insisting upon a fair return for their output. It is time for the coke interests to realize the necessity of closer co-operation to the end that the coke industry shall either secure a good price for its output or leave its incomparable coking coal in the hill where an increased future value will steadily accrue. It is several thousand dollars per acre nearer its natural markets than coke from other fields.

Producer Gas for Steaming Purposes

A full realization of the value of the byproduct gas which results from the coking distillation process has brought a widespread attention to the utilization of this gas. At the present time important plants are being operated in Europe in which steam boilers are being fired by means of the gas produced from a battery of coke ovens.

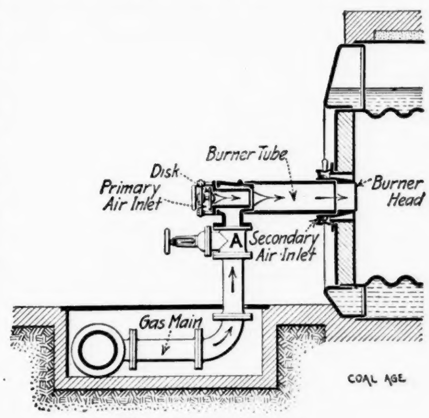
One fact, however, which is well known and generally admitted is that the economy of gas-fired boilers leaves considerable to be desired. The efficiency obtained by some of the present methods of firing boilers in this way is so small that in a good many cases it is not higher than 35 per cent., while an efficiency of 45 per cent. is considered a fairly satisfactory result.

The reason for this excessive waste is, of course, due to the very imperfect combustion of the gases and moreover, it can often be found that a considerable part of the gas passes through the furnace and into the stack without being made proper use of. It is therefore apparent that the subject of the complete combustion of coke-oven gas presents a problem which, although including many difficulties, yields an increased economy in operation which would be a material gain to the coke-oven plant and its adjuncts without involving any material increase in cost.

For this reason considerable attention has been paid to this part of the subject by combustion engineers, and one of the most favorable attempts at the solution of the problem is furnished by the Coke Oven Machinery Co., Ltd., of Twickenham, England, who have produced a furnace, known as the "Terbeck," which is designed on a scientific basis.

The Terbeck Burner

The furnace consists of a combination of one, two or more burners, the construction of each element or burner being that shown in the accompanying figures. The gas having passed a valve *A*,



Detail of Burner

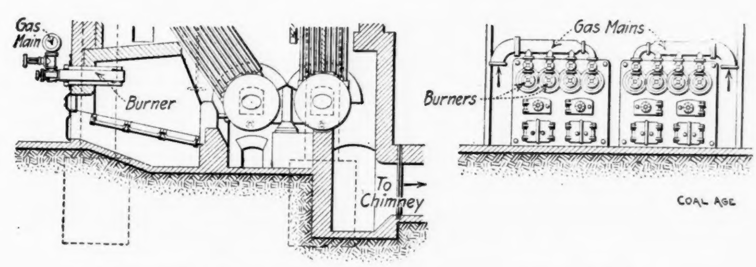
enters through an annular nozzle into the interior burner or wrought-iron mixing tube. The gas nozzle, which, owing to practical considerations, must not be smaller, nor larger than a given size, is of such a shape that in view of the chimney draft the energy of the pressure of the gas is converted as completely as possible into kinetic energy.

This latter is used for sucking the primary air, which is admitted through the disk valve shown, and for conveying the gas and air mixture into the interior burner tube. The length of this mixing tube is determined in such a manner that the velocity of the combustion mixture at its outlet is somewhat higher than the velocity of its explosive reaction and hence a continuous passage of the mixture into the furnace is insured.

In order to increase the durability of the arrangement a burner head of case-hardened metal is mounted at the end of the mixing tube. Moreover, this tube is surrounded by a concentric tube, extending as far as the front wall of the burner head and at the rear end of this outer tube there is an annular slide valve which serves for the introduction of the secondary air. The annular slide valve is fitted with handles in order that convenient and precise adjustment can be effected.

This double regulation is advisable because the adjustment of the primary air is necessary in order to suit the admission of the air to any fluctuations of gas pressure, while the regulation of the secondary air takes place in accordance with the changes of the primary air and the fluctuations of the chimney draft. The dimensions are determined in accordance with the demand made on the boiler output, having regard to the sliding valve and the gas pressure. According to the size of the boiler two or more burners are combined into one set.

The way in which these burners are mounted in boilers of general construction is shown in the accompanying drawing. It will be noted that the gas-fired furnace is combined with a coal furnace, the advantage of which is obvious. Evidently this method of firing can be used to an equal advantage in connection with blast-furnace gas and this is a most important feature, inasmuch as the



Showing Method of Applying Burners to Boilers

efficiency obtained from blast-furnace gases is even smaller than in other cases of gas firing.

The use of the Terbeck furnace, therefore, fired with blast-furnace gas in exactly the same manner as in other cases, not only produces an increased efficiency but is very convenient in reducing the space otherwise necessary for the combustion chambers and also allows of greater facility in attending to the steam and water gages. It may therefore be said that the Terbeck furnace indicates a most important advance in gas firing, inasmuch as it is claimed that in most cases the efficiency is increased to 75 per cent., a figure of 70 per cent. being guaranteed in almost every case. In other words, it is claimed that with 40 or 50 hp. obtained with gas firing under present methods, 70 or 75 hp. can be obtained either by firing additional boilers with the same quantity of gas or increasing the evaporation in the existing boiler plant.

Life of the Connellsville Region

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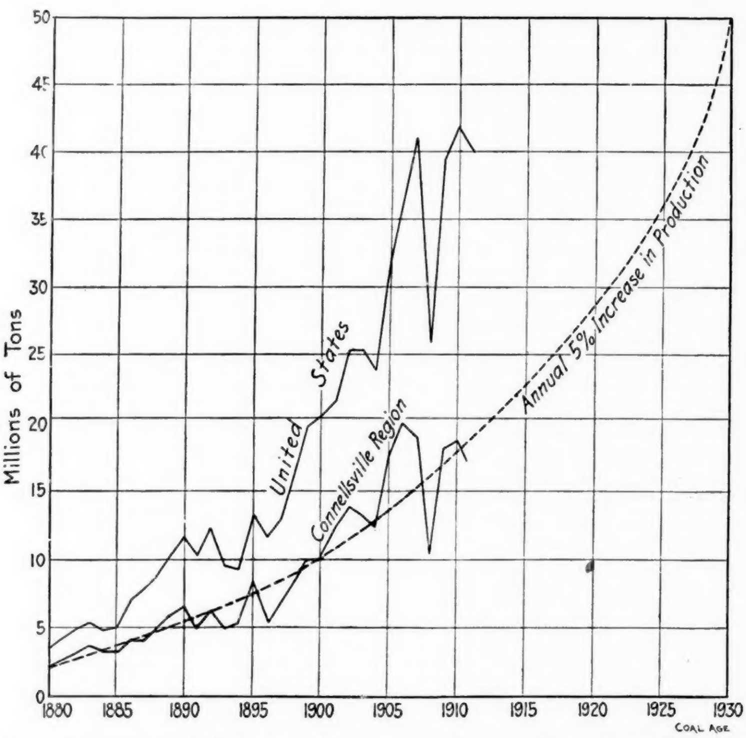

Diagram Illustrating Probable Future and Actual Past Coke Production of the Connellsville Region and Past Output of the United States

Note — Quoted from Connellsville Courier.

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hem and Philadelphia districts there are 53 stacks which utilize more than 3,500,000 tons of coke every twelve months. Some of these furnaces are comparatively small.

Owing to the centralized position of the Connellsville field it seems as if the stability and supremacy of Connellsville coke is assured providing that fair treatment is accorded the coke operators. As an investment the manufacture of coke should be safe. The coal in the hill is indestructible; it should not be given away as has been the case in the past two or three years. Its continued use is just as certain as the fact that our great industrial progress is bound to continue.

The ore people during the past few years have been receiving a fair margin of profit upon their product and it is time that the coke people were insisting upon a fair return for their output. It is time for the coke interests to realize the necessity of closer co-operation to the end that the coke industry shall either secure a good price for its output or leave its incomparable coking coal in the hill where an increased future value will steadily accrue. It is several thousand dollars per acre nearer its natural markets than coke from other fields.

Producer Gas for Steaming Purposes

A full realization of the value of the byproduct gas which results from the coking distillation process has brought a widespread attention to the utilization of this gas. At the present time important plants are being operated in Europe in which steam boilers are being fired by means of the gas produced from a battery of coke ovens.

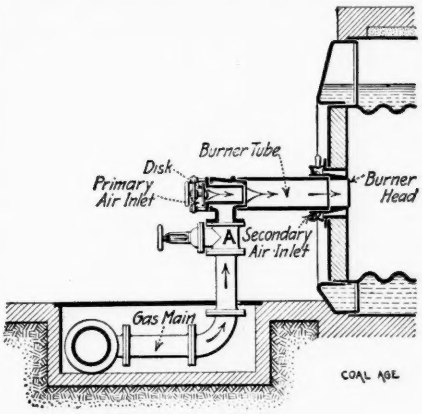
One fact, however, which is well known and generally admitted is that the economy of gas-fired boilers leaves considerable to be desired. The efficiency obtained by some of the present methods of firing boilers in this way is so small that in a good many cases it is not higher than 35 per cent., while an efficiency of 45 per cent. is considered a fairly satisfactory result.

The reason for this excessive waste is, of course, due to the very imperfect combustion of the gases and moreover, it can often be found that a considerable part of the gas passes through the furnace and into the stack without being made proper use of. It is therefore apparent that the subject of the complete combustion of coke-oven gas presents a problem which, although including many difficulties, yields an increased economy in operation which would be a material gain to the coke-oven plant and its adjuncts without involving any material increase in cost.

For this reason considerable attention has been paid to this part of the subject by combustion engineers, and one of the most favorable attempts at the solution of the problem is furnished by the Coke Oven Machinery Co., Ltd., of Twickenham, England, who have produced a furnace, known as the "Terbeck," which is designed on a scientific basis.

The Terbeck Burner

The furnace consists of a combination of one, two or more burners, the construction of each element or burner being that shown in the accompanying figures. The gas having passed a valve *A*,



Detail of Burner

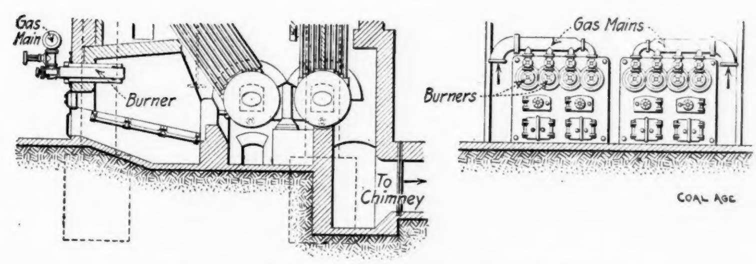
enters through an annular nozzle into the interior burner or wrought-iron mixing tube. The gas nozzle, which, owing to practical considerations, must not be smaller, nor larger than a given size, is of such a shape that in view of the chimney draft the energy of the pressure of the gas is converted as completely as possible into kinetic energy.

This latter is used for sucking the primary air, which is admitted through the disk valve shown, and for conveying the gas and air mixture into the interior burner tube. The length of this mixing tube is determined in such a manner that the velocity of the combustion mixture at its outlet is somewhat higher than the velocity of its explosive reaction and hence a continuous passage of the mixture into the furnace is insured.

In order to increase the durability of the arrangement a burner head of casehardened metal is mounted at the end of the mixing tube. Moreover, this tube is surrounded by a concentric tube, extending as far as the front wall of the burner head and at the rear end of this outer tube there is an annular slide valve which serves for the introduction of the secondary air. The annular slide valve is fitted with handles in order that convenient and precise adjustment can be effected.

This double regulation is advisable because the adjustment of the primary air is necessary in order to suit the admission of the air to any fluctuations of gas pressure, while the regulation of the secondary air takes place in accordance with the changes of the primary air and the fluctuations of the chimney draft. The dimensions are determined in accordance with the demand made on the boiler output, having regard to the sliding valve and the gas pressure. According to the size of the boiler two or more burners are combined into one set.

The way in which these burners are mounted in boilers of general construction is shown in the accompanying drawing. It will be noted that the gas-fired furnace is combined with a coal furnace, the advantage of which is obvious. Evidently this method of firing can be used to an equal advantage in connection with blast-furnace gas and this is a most important feature, inasmuch as the



Showing Method of Applying Burners to Boilers

efficiency obtained from blast-furnace gases is even smaller than in other cases of gas firing.

The use of the Terbeck furnace, therefore, fired with blast-furnace gas in exactly the same manner as in other cases, not only produces an increased efficiency but is very convenient in reducing the space otherwise necessary for the combustion chambers and also allows of greater facility in attending to the steam and water gages. It may therefore be said that the Terbeck furnace indicates a most important advance in gas firing, inasmuch as it is claimed that in most cases the efficiency is increased to 75 per cent., a figure of 70 per cent. being guaranteed in almost every case. In other words, it is claimed that with 40 or 50 hp. obtained with gas firing under present methods, 70 or 75 hp. can be obtained either by firing additional boilers with the same quantity of gas or increasing the evaporation in the existing boiler plant.

Washery Plant Control

By G. R. Delamater*

By selecting a fluid of the correct specific gravity, and dropping a sample of the waste from the washer into it, it can be seen if all the coal having a less specific gravity and therefore less than the predetermined impurity, has been removed.

Analyzing the waste by ordinary methods will show that coal is being lost, but whether that coal is combined with the permitted impurity or is purer coal is not proved. To avoid this the float test was devised.

The float test whereby we determine whether or not a washing plant is doing the work we require of it, is not new. It has been used for many years in making coal washery determinations. The test separates the slates and other impurities from the coal by their difference of specific gravity in a solution of a definite strength. The bodies which are lighter than the solution float, those which are heavier sink. The liquid is not moving so that the determination is not rendered uncertain by the intrusion of any other action than that of gravity.

The test is so exact that it is to be regretted that the method cannot be used for actual washing, but unfortunately the expense of the solutions employed makes their use for this purpose impracticable. The liquids commonly used are calcium- and zinc-chloride solutions. As these are expensive to purchase in large quantities, the use of the method is limited to testing the perfection of other systems of washing and no other method of rating washery practice gives equally reliable results.

Problems Solved by Float Test

When the product of a mine has not been washed heretofore, and is about to be subjected to that process, the test serves to show what amount of carbonaceous material must be thrown out to get a coal of which the impurities shall not exceed a certain percentage. It also determines the size to which that coal must be crushed to permit of the highest efficiency in washing.

It can be and is extensively used to test the efficiency of separation as it is performed in various washing devices. All washed coal, which is too full of impurity to show the desired percentage of carbonaceous material, falls to the bottom, the cleaner coal floats. As all the washed coal is supposed to be of less than a certain specific gravity, that of the liquid, the presence of any material which sinks shows that the washing is insufficient. Conversely if when testing the refuse from the washer any float is obtained, it shows that coal of the required purity is being wasted.

In the issue of May 25, a letter appeared discussing a recent paper in Mines and Minerals on the subject "Standards in Coal Washing." In that paper I gave a complete method of determining coal washery efficiency, coal loss, etc. These determinations were made entirely upon the float-and-sink test.

The usual method of making the float test is to place a liquid of the desired density in a receptacle of some sort such as a bucket or dish pan. The sample of coal to be tested is dropped into the liquid and stirred so as assure that the material will become thoroughly wetted. The denser particles fall to the bottom and those of lesser specific weight rise to the surface.

After the liquid becomes still, the floating material is skimmed off and the liquid poured into a filter. The sink is left in the pan where it may be rinsed with clean water, dried and weighed. The float is also subjected to rinsing, drying and weighing. Thus the percentages of float and sink can be calculated.

Difficulty of Handling Large Samples

Where the coal examined is finely crushed, small samples are not objectionable, but if the material be in pieces ranging from fines to 1 in. or 1¼ in. in diameter, then it is almost absolutely necessary that large samples be used for float tests, otherwise one large piece of coal or a large piece of rock may greatly affect the results one way or the other.

Because, with the old method, the specific-gravity liquid must be filtered and therefore handled several times, it was only to be expected that the samples used for float tests would be smaller than desirable because it was difficult to handle the large amount of liquid such large samples required.

The Delamater float-and-sink testing appliance does away with all the objectionable features of the float test and makes it possible to make tests of samples either large or small, the standard 10-in. machine being suitable for samples of any quantity up to 4 or 4½ pounds.

The Sieve Pans

The body of the appliance is of cast iron and is practically indestructible. It forms a tank *A* in which is contained the liquid which may be of any density desired, depending upon the coal to be tested. Conveniently arranged within the tank is a metal frame which supports the two 10-in. diameter laboratory sieve pans, side by side on the same level.

These lie within the tank and cannot be seen in the illustration. The frame is so constructed and arranged that, by turning the crank shown in the illustration at the right-hand end of the machine, the frame (and of course the pans on it) may be raised or elevated until it rests in a position above the surface of the liquid. In this manner, the pans may be held in a draining position above the solution, or may be immersed until they rest at the bottom of the tank.

The "Float" Cylinder

A cylinder *C*, here shown resting over the left or "sink" pan, has both ends open, and is of a diameter slightly less than that of the sieve pans. It is so arranged that it may hang above either the left- or the right-hand pan as desired, the bottom of the cylinder just clearing the tops of the pans when they are at their lowest position. The supporting arms of the cylinder rest upon two screw rods, situated one on each side of the tank and at the top of the same.

One of these *D* is clearly shown in the illustration. The other is hidden from view but the crank *B*, by which it is operated can be seen clearly on the right. Suitable "dogs" on the supporting arms engage the threads of these screw rods and are so arranged that, when thrown into position, the cylinder *C* is caused to travel horizontally by turning the crank *B*. Both screw rods are operated by one crank, one rod being driven by the other by means of suitable chains and sprockets.

By a simple and convenient arrangement of the gearing which raises or lowers the pan frame as desired, the gears may be thrown out of mesh when the operator desires to transfer the cylinder, or in mesh when the pan frame is to be elevated or lowered. In the latter case the cylinder "dogs" are thrown out of mesh with the screws and the cylinder remains stationary.

Getting the "Sink"

The operation of the apparatus in testing coal or refuse is as follows: The two sieve pans are placed in position on the frame and lowered to the bottom of the tank. The cylinder is placed over the left-hand pan. Then the frame is elevated until the wire-cloth bottom touches the

*Philadelphia, Penn.

cylinder, thus forming a bottom for it. The coal sample is then deposited in the liquid of the cylinder and thoroughly stirred with a stick to the end that all particles may be thoroughly wetted and freed from one another so that they will either sink or float according as their specific gravities are higher or lower than that of the liquid used.

The pan frame is then lowered to the bottom and the apparatus left until the particles have all had time to take their proper positions, or in other words, until the liquid in the cylinder has cleared. About fifteen minutes is usually sufficient for this purpose and meanwhile the operator may prepare other samples or attend to duties of a different character.

Transferring the "Float"

The gear is then thrown out of mesh and the cylinder transferred slowly across the tank to a position at *F* directly above the right-hand pan, the float within the cylinder being of course carried along with it. The gears are again thrown into mesh and the frame elevated until the pans rest in a draining position above the surface of the liquid. As this is done the wire-cloth bottom of the right-hand pan comes in contact with the bottom of the cylinder, closing it, and as the pan continues to rise, the cylinder is lifted with it, the liquid draining off and leaving the float in the pan.

We thus have the sink in the left-hand pan and the float in the right. The pans are then removed from the appliance, the cylinder still resting within the float pan. By means of a small water hose the particles adhering to the cylinder are washed down into the pan and the cylinder removed.

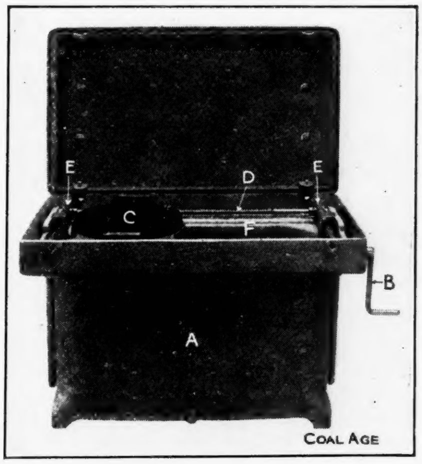
Both float and sink samples are then thoroughly rinsed with water in the pans in order to remove all traces of the chloride, and then both pans are placed in a dryer until the samples are dry, then weighed and the pan weights subtracted. From 60- to 100-mesh wire cloth is used in these pans, depending on the coal tested.

In order that none of the very fine material will be lost through the screens in rinsing, the pans are placed on a slightly inclined table built for the purpose, the run-off from which goes into suitable receptacles placed at the lower edge of the table. The fines are thus caught and are allowed to settle after which the water is carefully drawn off. The residue may be dried in a dryer and added to the rest of the float material.

Ordinary Methods Waste Some "Float"

As has been shown, the liquid has not been removed from the apparatus, nor have the samples been touched after being put into the liquid. As a result there is no chance of losing any of the samples such as there is in the usual method of "skimming off the float." As the tank holds a considerable amount of liquid, the water carried by a well-drained sample will not be sufficient to make measurable reduction of the gravity of the liquid where making from two to four tests a day. Ordinary evaporation will raise the gravity of the liquid about a point a day and the use of a limited number of wet samples will affect the results but slightly, in fact, not enough to be detected in the percentages of float and sink.

The apparatus may be located in the washery if desired and a sample of the refuse may be tested as often as thought necessary. Thus the detection of any increase in the coal loss is quickly made. When making such a quick test, in order that the time need not be taken to dry the sample completely before using, it may be placed in a bucket with a few small holes punched in the bottom and swung until the free water is thrown off. This will leave the sample damp but there will not be enough water to affect the gravity of the solution over a small fraction of a point.



The Apparatus by Which the Float-and-sink Test Is Made

Estimate of Efficiency Can Be Made with Wet Coal

If the float and sink are both weighed wet, their percentages will vary but little from that obtained by weighing them dry. There is a small difference but this will be found constant for the same material and if this constant is determined by trial, it can always be added or subtracted as found necessary from the results of the test and the samples thereafter weighed wet. This will save considerable time and will enable the washer boss to make quick determinations, adjusting his jigs when an increased coal loss occurs instead of a day or so after. In the past this long delay has been necessary because the test as ordinarily made is quite slow.

Tests may also be made frequently of the washed coal to detect any increased presence of free refuse matter therein, and of raw coal also for the detection of any variation in its composition. The washery boss who at all times has an absolute knowledge of the composition of his raw coal, washed coal and refuse, can most certainly produce more uniform results than can be approached by one without this information.

He is also in a better position to study his coal losses and other imperfections of his washery system and can make improvements from time to time which soon will more than pay for the cost of his testing appliance and the expense of making the tests, which by the way, amounts to but a few cents a month. The regular washery men can make the tests and a chemist is not needed for operating the appliance, the expense being only that of the small amount of chloride required to replace that carried away by the samples.

This appliance is made by the Pennsylvania Crusher Co. of the Stephen Girard Building, Philadelphia, Penn.

Longwall Mining

With a bad roof, the pillar-and-chamber system of mining calls for narrow entries and rooms, which greatly reduce the output, increase the yardage cost, as stronger explosives are necessary, and also increases the danger of blowout shots, as the holes are apt to be drilled too deep, in order to increase the tonnage.

Such mines should be worked by the longwall system, as a greater tonnage can be produced at less cost per ton with this method, and there will be a great saving in the cost of dead work and timbering. The mines are also safer, as the roof pressure will be uniform at all times, while the amount of packing required is reduced to a minimum. In some instances, coal worked by the longwall method falls of its own accord after undercutting. This still further reduces expenses, as little or no explosives are required under these conditions.

Byproduct Ovens

The several different types of byproduct ovens have developed from three different forms: The modified bee-hive oven, which is an application of recovery apparatus to the bee-hive form. The vertical flue retort oven, starting with the Coppee oven, and exemplified in the modern Otto and Koppers oven. The horizontal flue type starting with the Knab-Carves oven, and exemplified by the modern Semet-Solvay type.

The Kros Regenerative Coke Oven

By Alfred Gobiet*

One of the most troublesome features in the modern retort oven, the difficulty in maintaining constant temperature in the oven walls, is claimed to have been solved by the Kros design. Draft reversal in the heating flues, as now commonly practiced, is eliminated, and is confined entirely to the regenerators. Another novel feature consists of equalizing chambers for maintaining constant gas and air pressures.

A greater appreciation of the economic value of the coke-oven byproducts, together with the growing popularity of the evolved gases for both light and power purposes, has resulted in an active development in the design and construction of coke ovens during the past few years. Endeavors have been directed particularly toward obtaining regular heating of the oven, thus insuring the minimum of time for burning and effecting the greatest possible recovery of the waste gases.

One of the important features, which has been receiving the attention of coke engineers, is the construction of the flues for conducting the hot gases which provide the heat for the walls of the oven. An improperly designed system of flues will often result in irregular coking of the furnace charge. Leakages also often occur in furnace walls after long service, and this results in the heating gases escaping into the coking chamber, and the gases of distillation into the heating walls during the respective periods of alteration, the ultimate result being an inferior grade of coke, as well as of byproduct gases, and an ineffective system of heating.

*Engineer of the Witkowitzer Coal Mines, Ostrau, Moravia, Austria.

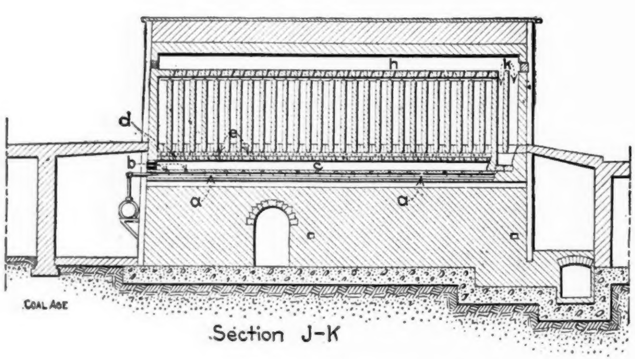
Note—Translated from the "Montanistische Rundschau," Vienna, Apr. 16, 1912.

System of Operation

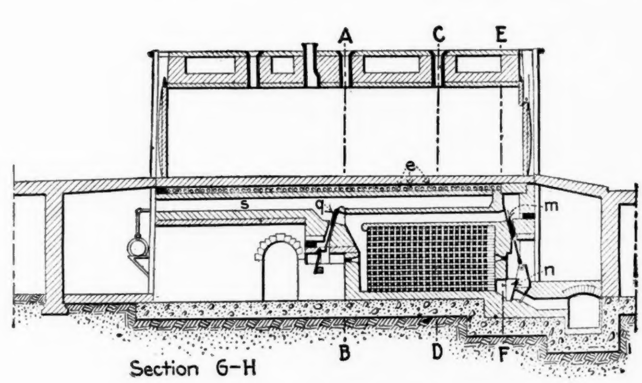
In order to equalize the detrimental effects of draft alterations as much as possible, the changes of draft are divided among several combustion sections by some systems. There always remains, however, the proportion of directly heated sections as well as those indirectly heated.

In the regenerative coke oven here described, known as the Kros oven, the draft change is entirely avoided in the heating walls, and is limited to the reversal of the regenerators. An experimental section of four of these ovens were installed at the Holland colliery near Wattenscheid over a year ago, and they have given every evidence of meeting with the results expected from them during the period of operation since that time. In the accompanying illustrations are shown several sectional views of the Kros ovens.

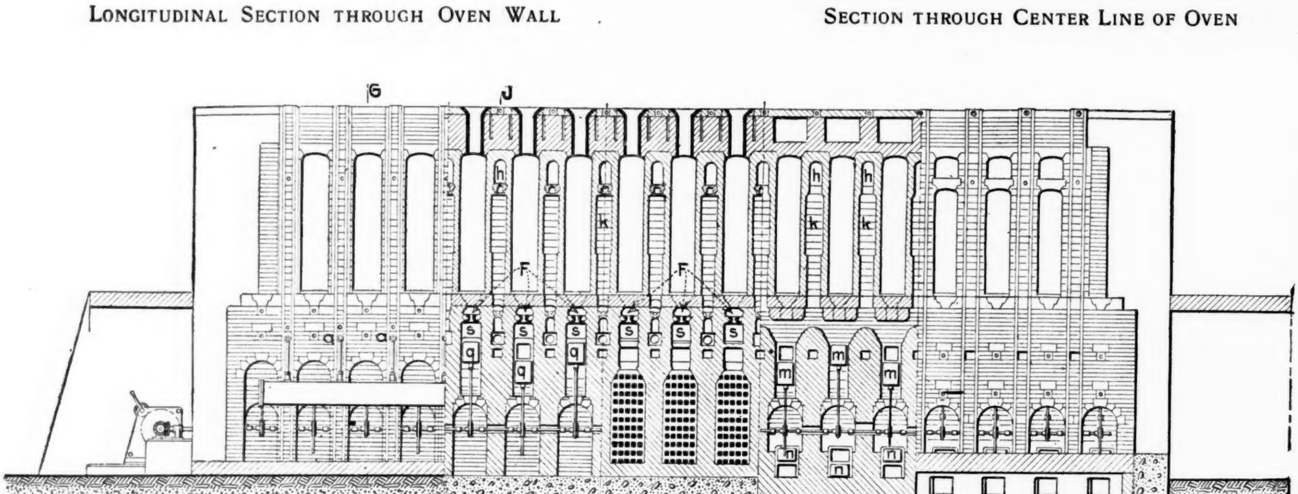
The heating gas flows through a main *a*, under the oven, through the nozzles *b* into the pressure equalizing chamber *c*



Longitudinal Section through Oven Wall



Section through Center Line of Oven



General Section through a Battery of Kros Ovens

and then through the nozzles *d* into the heating flues where combustion takes place with the preheated air which flows in through the two openings *e* arranged slightly above each gas burner. (See section J-K). The heated gases rise through the flues along the entire oven side, and the combustion products then pass through the passage *h* near the top of the ovens and descend through the main *k* at the back and into the checker brickwork regenerators below, the slide gate *m* being open. The exhaust gases of the two heating walls are drawn out of the regenerator, the slide gate *q* being closed, and escape through the chimney flue and out into the chimney at a temperature of about 290 deg. C.

Regenerators

Under each oven chamber is a regenerator extending half the length of the chamber, as shown in section G-H. As already mentioned, the draft reversal is limited to the regenerators, draft conditions in the heating walls being constantly maintained the same. From each pair of heating walls the exhaust gases flow into the same regenerator, while the next regenerator is furnishing these two heating walls with preheated air for combustion. Thus during the period when the odd-numbered regenerators are running on exhaust gas, the even-numbered ones are being traversed by fresh air.

The reversal of the generators is performed by means of the slide gates *m* and *q*, made of a special quartz material, and by means of the cast-iron slide gate *n*. These gates are operated by means of a sprocket chain meshing on a sprocket wheel; these wheels are mounted on shafts under the battery of ovens, and are turned by a hand crank positively connected with both shafts. The gate *n* is also opened and shut by means of a shaft on the machine side.

In sections A-B and E-F the positions of the gates *m*, *q* and *n* are shown when the exhaust gases are passing through the regenerator. During the same period the neighboring regenerator serves for preheating the air of combustion when the gates *m* and *q* are closed, and the gate *n* is open. The preheated air flows out of the regenerator chamber through the main *s* and by means of the nozzles into the pressure equalizing main *F*, and hence on through the openings *e* to the points of combustion in the two heating walls.

The Pressure Equalizing Main

According to the conclusions arrived at by Dr. Otto after various experiments, a pure coke oven gas when burned with air yields higher temperatures than are necessary for coking, only care must be taken to avoid too early escape of the heat, or in other words, the gas velocities or pressures in the oven passages must be low. Since, however, when employing small velocities, there is trouble in supplying regular quantities of gas from this comparatively small-sized piping, and since, with the increasing distance of the burners from the inlet of the gases to the connecting pipe of the burner, the pressure, and with it the flow-velocity, is reduced, the system here described has been designed with a pressure equalizing main for the purpose of overcoming these difficulties.

This collecting main shown at *c* is connected with the lower gas main *a* by the interchangeable regulating nozzles *b*. The cross-section of the main *c* is considerably larger than that of the gas main *a*. By a proper adjustment of the nozzles *b*, a uniform pressure is obtained throughout the whole length of the passage *c*.

Vertically below each heating flue the gas collecting main has an opening covered with the nozzle plates *d* of equal orifice. Since the outflow velocity of the heating gas at each nozzle is the same, a like quantity of gas flows through each nozzle plate into the heating chamber, which is equivalent to supplying equal quantities of heat for each heating flue. Care is also exercised to regulate the exhaust gas of the flues by provision of interchangeable regulating nozzles between the heating flues and the exhaust main *h*.

Air Equalizing Main

In order to furnish a regular supply of combustion air, there is likewise provided for this purpose a pressure equalizing main *F*. The interchangeable regulating nozzles, which are made with openings of different sizes, are all of plate form, and are set in hollows of the masonry deep enough to allow for pushing the new nozzle directly over the old one when interchanging nozzles.

The coal coked at the Holland mine contained about 18 per cent. of volatile constituents, and the resulting coke was of good composition. The time of coking was 28 hours for a charge of eight tons of dry coal per oven. The water content of the coking coal averaged 13 per cent.

The production of gas per ton of coal amounted to 240 cubic meters, of which about 110 cubic meters were expended per ton of charge in heating an oven. The gas remaining for other purposes amounted, therefore, to about 54 per cent.

It is interesting to note that the results of the experiment with the four ovens originally installed were sufficiently satisfactory to cause the same concern to construct a large plant of these ovens which is now in successful operation.

All mine drivers should be provided with portable seats, adjustable to either end of the car, and riding on any part of the car other than the seat should be strictly forbidden.

Coal Output in Tennessee

The production of coal in Tennessee in 1911 was 6,433,158 short tons, valued at $7,209,734, according to a statement just made public by the U. S. Geological Survey. This was a decrease from the output of 7,121,380 short tons, valued at $7,925,350, in 1910, of 9.66 per cent. in quantity and 9 per cent. in value. Notwithstanding this rather notable decline, the output for 1911 was larger than that of 1909 and exceeded that of any preceding year except 1907.

The lessened production in 1911 is not indicative of any decline in the coal-mining industry of the state, for comparison with a series of preceding years shows that the tonnage was normal, and there was a small advance in the average price. Tennessee, in common with the other states of the Appalachian region, benefited by the long strike among the miners in the Mississippi Valley states in the spring and summer of 1910, and production was unusually stimulated. The decreased tonnage in 1911 was simply a return to normal conditions.

Nearly 25 per cent. of the entire decrease was in the quantity of coal made into coke, which declined from 615,558 tons in 1910 to 461,963 tons in 1911. The quantity of coal made into coke represents considerably less than 10 per cent. of the total output. In 1911 the number of men employed in the Tennessee mines was 10,703. The average production for each employee was 601 tons; the average daily production per man was 2.59 tons.

Tennessee's record with regard to the methods employed in the mining of coal is fair. Operators producing about 80 per cent. of the total output in 1911 reported that 43.9 per cent. of their total production was mined by hand, 15.6 per cent. was undercut by machines, and 40.5 per cent. was shot from the solid. It may be inferred, therefore, that nearly 60 per cent. of the coal produced was undercut before being shot or wedged down.

Gas Liberated after Mining

Investigations made by the Bureau of Mines have shown that gas not only escapes from some coal during mining but also after the coal is mined. It was found in one instance that in the two weeks immediately following the mining, methane equal to three-fourths the volume of the coal was liberated. It was estimated that each cubic foot of the coal, set free, during its mining and in the first two weeks thereafter, one cubic foot of methane, while during the first 5 months after mining it liberated a volume of methane equal to 1¾ times the volume of the coal. At first the gas escapes rapidly, then gradually diminishes and stops altogether in from 3 to 18 months.

Current Coal Literature

The Best Thought Culled from Contemporary Technical Journals, Domestic and Foreign

Why Some Coals Coke

By Vivian B. Lewes*

It is clear that in a mass of rotting vegetation undergoing decay, fermentation must play an important part, and Renault[1] found, in an extensive series of researches upon peat, that the most important factor in the conversion of vegetable deposits into peat were fungi and bacterial ferments, which give rise to the production of ulmic compounds of the composition: Carbon, 65.31, Hydrogen 3.85, and Oxygen, 30.84 per cent.

Mulder[2] also at an earlier period found that bodies could be extracted from peat, to which he gave the name of humic and ulmic acids and Einof, Proust and Braconnot found that such bodies form the chief portion of peat.

HUMIC AND ULMIC ACIDS IN PEAT

Elements	Humic Acid	Ulmic Acid
Carbon	60.13	62.03
Hydrogen	4.74	4.65
Oxygen	31.52	33.33
Nitrogen	3.61	..
	100.00	100.01

Whilst Herz[3] found bodies of the same character in lignites, which he called carbo-humic and carbo-ulmic acids, of the composition:—

CARBO-HUMIC AND CARBO-ULMIC ACIDS IN PEAT

Elements	Carbo-humic Acid	Carbo-ulmic Acid
Carbon	64.59	62.36
Hydrogen	5.15	4.77
Oxygen	30.26	32.87
	100.00	100.00

Fremy[4] also found that not only lignites but bituminous coals could be dissolved in a mixture of mon-hydrated sulphuric acid and nitric acid, giving a dark brown solution, from which an ulmic compound is entirely precipitated by water: whilst Anderson[5] has shown that by similar treatment bodies of the same character can be obtained from both caking and non-caking coals.

The Humus Bodies Apparently Contain The Nitrogen

None of these bodies are probably definite compounds. They resemble the residues obtained by the action of dilute acids on sugar and starch. The evidence however, seems to point to the presence in all bituminous forms of coal of degradation products of the original vegetation which are of a humus or ulmic character. This is probably the portion carrying the nitrogen, and in round numbers the proportions of the carbon, hydrogen and oxygen will be not far removed from Carbon, 63 per cent.; Hydrogen, 5 per cent.; Oxygen, 32 per cent.

Gums and Resins in Coal

It is also well known that the tertiary coals, like the brown coal and lignite deposits, are rich in fossil gums and resins, derived from the extractive matter of the vegetation, and a number of these have been isolated and analysed, whilst Mulder has found resinous bodies of a similar character in the Friesland peat.

It will be noticed that the products from the lignite differ but little from Mulder's peat resins, whilst it is interesting to note that in the lignite beds of Saxony layers of opaque yellowish brown matter are found (the pyropissite of Kenngott), which yields up to 62 per cent. of paraffin on distillation, and is the body from which Wackenroder and Bruckner extracted their resins.

It is evident that in coal there are resin bodies of this character approximating to the general composition—Carbon, 79 per cent; Hydrogen, 11 per cent.; Oxygen, 10 per cent.

Primeval Vegetation Partly Resinous, Partly Non-Resinous

The amount of the resinous constituents in the original vegetation and the degree to which they are concentrated in the mass must modify the chemical changes taking place during the formation of the coal and thus its ultimate composition. It is clear that although the vegetation that flourished in the coal age was of a very different character to that of later periods, yet in all probability the variations in the extractive matters of the plants varied to much the same extent as in the flora of today.

Consequently some deposits would be formed from vegetation containing but little of the resin-forming constituents, whilst other deposits would be rich in them. We know the wide differences there are in the physical characteristics of the lignites. Sometimes they are more like wood than coal, at others they are black and shining and have a conchoidal fracture. These variations in appearance are due to the conditions under which they have been formed and to the amount of the resin constituents present.

COMPOSITION OF RESINS IN PEAT AND LIGNITE

	Source	Observer	Carbon	Analysis Hydrogen	Oxygen	Name
Dark Peat	Friesland	Mulder	76.31	10.98	12.71	Beta-resin
	"	"	78.05	11.94	10.01	Gamma-resin
	"	"	79.70	12.15	8.15	Delta-resin
Light Peat	"	"	75.12	10.21	14.67	Alpha-resin
	"	"	79.43	12.54	8.03	Gamma-resin
	Saxony	Wackenroder	78.20	12.30	9.50	Cerinin
	"	"	81.97	11.47	6.56	Leucopetrin
	"	Bruckner	77.35	10.20	12.45	Georetic acid
Lignite	"	"	80.27	13.37	6.36	Geomyricin
	"	"	78.64	12.70	8.66	Geoceric acid
	New Zealand	Hauer	76.53	10.48	12.80	Ambrite
	Bohemia	Laurentz	81.47	8.71	9.82	Anthracoxene
	Moravia	Schrotter	80.40	10.68	8.74	Retinite
		Mean	78.65	11.36	9.88	

Resins Act as Binders and Preservatives

The resinous constituents in the peat deposits of today constitute only 5 to 10 per cent. of the whole material, but in the decaying vegetation of the carboniferous age they were probably present in much larger proportions. The humus of present day peat bogs, unprotected by large quantities of resinous bodies, rapidly undergoes decomposition. Thus the carbon is concentrated and methane, carbon dioxide and water are evolved.

As the layers of deposit above the carbonising mass grow thicker, the temperature probably rises, and the ratio of resin constituents, increasing in proportion, binds together the mass and so helps to protect the remaining humus. Thus with the lapse of centuries, lignite is formed.

Note—Part of the Cantor lectures on the "Carbonization of Coal," read before the Royal Society of Arts.

*Royal Naval College, Greenwich, Eng.

1. Bulletin de la Société de l'Industrie Minérale, 3 Ser., XIII, p. 865.
2. Jour. fur Chem., 21, p. 321.
3. N. repert, 10, p. 496.
4. Die Physiographie der Braunkohle, p. 5.
5. Journal Soc. Chem. Ind., XVII, p. 1018.

If the amount of resin constituents has been small or owing to local circumstances has not been distributed evenly throughout the mass, the lignite is loose in structure, and during the ensuing ages continues decomposing until, if the pressure has been great and the temperature high, nothing but the residual basis and trace of resin constituent are left in the form of steam coal or anthracite, whilst under other conditions they may remain mixed with the bituminous coal in a seam and form the "Mother of Coal."

How Cannels and Kerosene Shales are Formed

If the percentage of resin bodies has been very large, as in a drifted deposit of spores from lycopodia, and the temperature has been high, the resin bodies may become semi-liquid and mingling with surrounding earthy deposits will give such compounds as the Boghead cannel, the organic matter in which has the same composition as resin, whilst it yields 33 per cent. of ash. Some of the cannels however are simply very rich bituminous coals.

Whenever the temperature has been high enough, some of the resin constituents have practically distilled into the underlying clay, yielding some forms of bituminous shale.

The Resins May be Changed by Heat

Heat also may cause isomeric and other changes in the resins thus altering their behaviour towards solvents. The effect of heat under pressure upon the resins is in some cases to decompose them with formation of hydrocarbons. A long series of these were isolated by Renard. Among them were both saturated and unsaturated groups, together with hydrocarbons containing oxygen.

Compounds like retene, $C_{18}H_{18}$, have frequently been isolated. Retene is found in many lignites, and within the last few months Pictet and Ramseyer have isolated from coal hexahydrofluorene, $C_{13}H_{16}$, and others of the hydroaromatic hydrocarbons. These bodies are resolved into aromatic hydrocarbons and hydrogen during destructive distillation.

From the resin oil obtained by distilling wood rosin at a low temperature (662 deg. F.), Renard long ago isolated not only saturated hydrocarbons like pentane and hexane, but also hexahydrides or naphthenes, isomeric with the ethylene series. Among these hexahydrides were C_7H_{14}, C_9H_{18}, and $C_{10}H_{20}$, and the presence of bodies of this character in low temperature coal tar is a further proof of the presence of the resin bodies in coal.

All these degradation products of the original vegetation are to be found in the bituminous coals, the residual body and humus forming the basis, which is luted together by the hydrocarbons and resins. The characteristics of the various kinds of coal are dependent upon the proportions in which the four groups of the conglomerate are present.

The Formation of Gas From Heated Humus

These constituents of the coal have their own characteristic products of decomposition when the coal is subjected to carbonisation. The humus bodies during that process yield a large proportion of the gaseous products, and under the influence of heat show no sign of melting, but begin to break up at about 572 deg. F., the decomposition becoming more rapid as the temperature rises.

Water distils over in the early stages, the tar is thin and poor in quantity, and the gases up to 1112 deg. F. consist of hydrogen, methane and carbon dioxide, with smaller quantities of carbon monoxide and traces of other saturated hydrocarbons. The decomposition can be completed below 1472 deg. F. but if the temperature is run up to 1832 deg. F. the carbon dioxide is reduced in quantity because the red hot carbon acts on it forming carbon monoxide. But hydrogen and methane continue to be evolved.

The decomposition of the humus is also largely affected by the rate of heating; if slowly heated, a large proportion of the oxygen is given off in combination with hydrogen as water vapor, but if the coal is quickly raised in temperature more oxygen combines with the carbon to form carbon dioxide and monoxide.

The residue shows no sign of caking, but, like the naturally formed residue—mother of coal, it requires a large proportion of cementing material to make the particles cohere.

The Action of the Resins When Heated

The resinous bodies and hydrocarbons which form the cementing portion in the coal melt between 572 and 608 deg. F., and if a coarsely powdered sample of the coal becomes pasty or semi-fluid at this temperature, it is a strong inference that the coal will coke on carbonisation. This fact was noted by Anderson, and I have found it useful in practice as a rough test of coking qualities. At about these temperatures also the resinous bodies and hydrocarbons begin to decompose.

The resinous bodies at low temperature yield saturated hydrocarbons, some which are unsaturated, chiefly hexahydrides or naphthenes, and also some oxygenated compounds. The hydrocarbons yield paraffins and liquid products but all these primary constituents undergo further decomposition at slightly higher temperatures.

The liquids so produced begin to distil out as tar vapors and hydrocarbon gases, and leave behind with the residuum, pitch, which at 932 deg. F. forms a mass already well coked together if the residuum from the humus is not too large in quantity. The coke formed at this temperature is, however, soft, but if the heat be now raised to 1832 deg. F. the pitch residue undergoes further decomposition, yielding gas and leaving carbon, which binds the mass into a hard coke.

Amount of Combustible Gas and its Richness not Determined by Volatile Content

It has been shown by Muck and other observers that it is not always the coal containing the largest amount of volatile matter that evolves gas most rapidly or is richest in hydrocarbons. This naturally follows from the fact that those coals which have the highest oxygen percentage are mostly those showing high volatile matter. These coals are rich in the humus bodies which yield most of the diluting gas and but little tar or rich hydrocarbon gases. They cannot give the high result of a coal in which the oxygen content is about 10 per cent. or rather lower, and which contains a large percentage of resin bodies.

Why Coke Holds Together

Observers have differed as to the nature of the binding material in coke, some holding that it was the residuum of the semi-fused constituents of coal. Others, chief among whom is Wedding, consider that it is carbon shed off by the decomposition of heavy hydrocarbon vapors. This is undoubtedly the cause of the carbon hairs found in coking. My own opinion is that the cementing material is due to liquid products, the most volatile of which go off as vapors leaving pitch, which carbonises and binds the mass into coke, and in considering the actions taking place during carbonisation ample proof of this will be adduced.

It is clear that the binding material is formed below 842 F. deg., for if we take a good coking coal and carbonise it at that temperature we obtain coke which, although not strong, is perfectly luted together; but if we now powder this low temperature coke and again carbonise it, a large yield of poor gas is evolved, but no coking of the residue takes place.

The Resins Give Coal its Coking Power if Weathering has not Impaired Them

I am sure that it is the resinous bodies and their derivatives the hydrocarbons in the coal which form the tar. This yields the pitch which lutes the coke. I am positive also that the resinous bodies play

a very important if not the chief part in the weathering of coal.

Experience shows that the change during storage is a phenomenon which is dependent upon the absorption of oxygen from the air, and this weathering is fatal to the coking of some coal, the slack of which is so susceptible to oxidation that a few days' or weeks' exposure destroys its coking power.

Now the avidity of oxygen for some vegetable resins is well known. The rapidity with which copal will absorb oxygen from the air may be taken as an example. Common rosin has itself been formed by the oxidation of turpentine, and countless ages under conditions tending to reduction may well have whetted anew the resinic appetite for oxygen.

The Resins Cause Spontaneous Combustion

In any case the resinous bodies are the compounds present in the coal most likely to possess this property. The chemical actions so caused lead to slow combustion and, when accelerated by any rise in the surrounding temperature, are capable of generating sufficient heat to lead to the spontaneous ignition of such masses of broken coal as are large enough to prevent the heat from escaping as fast as it is developed.

Coal exhibits to a lesser extent the same property of absorbing gases which charcoal does, and the least absorbent will take up one and a quarter times its own volume of oxygen, while many bituminous coals will absorb more than three times their volume of the gas. This action, at first largely physical, probably presents the oxygen in an active condition to the resinous bodies in the coal, and leads to the rapid "weathering" and destruction of the coking properties which are characteristic of some coals.

Weathering Converts Resins to Humus Bodies

Boudouard[1] has shown that when coal is weathered humus bodies are produced and the coking power lessened or destroyed. In seven samples of various coals the humus constituents were increased by the oxidation, which seems to show that the action of the absorbed oxygen is to attack the resin compounds. As we know that carbon dioxide and moisture are the chief products during the earlier stages of spontaneous combustion of coal, it seems probable that the result is a conversion of resinic into humus bodies with evolution of these gases.

It is this change which leads to the serious deterioration in the gas and tar made from coal which has been stored too long, and the fact that a cannel coal like the boghead or a bituminous shale do not weather is partly due to their dense structure. It is also an indication that the resin bodies of which they are chiefly composed are of a different type, a fact borne out by their resistance to certain coal solvents which freely attack the ordinary resin matter.

Loss of Byproducts in Storage

By J. V. Freeman*

During the last few years much has been written and considerable experimental work done to determine the loss of heat units resulting from storage of coal. But little, if any information, can be found regarding the probable loss of byproducts from this cause. A serious loss confronts the coke manufacturer who may have to stock several thousand tons of coal for reserve purposes.

Laboratory Investigations

I have made several destructive distillation tests in a laboratory, on a number of samples before and after weathering to determine what these losses are. The initial results, although not conclusive, might serve to give an approximate idea of the losses which occur during the weathering and storage of coal. The following figures were obtained by experiments on a bituminous coal from the Pocahontas district, which had an average of about 20 per cent. of volatile matter with low ash and sulphur.

LABORATORY YIELD IN BYPRODUCTS PER NET TON

	Before Stocking	After 6 mo. Stocking	% Decrease
Lb. ammonia (NH_3)	4.1	3.5	14.6
Lb. benzol (crude)	13.3	9.1	30.5
Gallons tar	4.8	2.9	39.5
Cu.ft. of gas	10,043	9,425	6.1
B.t.u. per cu.ft. of gas	554	504	9.0
B.t.u. per lb. of coal	2,586	2,345	9.31

VOLUMETRIC ANALYSIS OF GAS FROM ABOVE COAL

	Before Weathering	After Weathering
Nitrogen	5.4	6.5
Hydrogen	62.5	61.3
Methane	26.5	26.4
Illuminants	2.0	1.2
Carbon monoxide	3.6	4.5
	100.0	99.9

These figures give the laboratory results which might not agree perfectly with practice.

Other Tests

When tests were made on coal which had been heated by spontaneous combustion, the loss of byproducts was found to be greatly increased, the sulphur in the coal was lowered owing to the rapid oxidation of the sulphur compounds and the volatile matter decreased in this experiment about 33⅓ per cent. As regards the constituents of the gas, the hydrogen and carbon were greatly increased, while the methane and illuminants were decreased. Still more important is the fact that a coking coal on continued exposure will lose its coking properties in addition to the losses that have already been mentioned.

*Joliet, Ill.

Device for Making Flame Caps Visible

Among the simplest of the many suggested tests for firedamp in mines is one that has recently been described in the Scottish Society of Arts. It is an attachment that may be applied to any oil or spirit safety lamp, and consists of a loop of copper wire supported on a brass rod passing through the oil vessel.

To make a test with this device, the loop is moved into the flame by a twist of the rod. The flame instantly becomes nonluminous and if firedamp is present in the air the gas cap is clearly seen. The test can be made in a moment, at any time, without turning down or putting out the light. It is claimed that the percentage of gas which this method will detect is quite small, and the results of trials in both the laboratory and the mine go to show that this is one of the most sensitive, accurate, and expeditious means of revealing the presence of inflammable gas in the mine air. As is well known, it is the luminosity of the flame that renders the gas cap invisible in making the flame test, and makes it necessary to draw down the flame in the ordinary method of testing

Semet-Solvay Ovens

The Semet-Solvay oven is construced so that the ovens proper are not an integral part of the structure; that is to say, the oven linings bear no part of the weight of the superstructure. Between each two ovens there is an 18-in. division wall which not only takes all the weight of the top pavement and coal larry, but also acts as a storage reservoir for heat.

Practically all retort ovens are rectangular chambers 30 to 40 ft. long, 16 to 24 in. wide, and 6 to 10 ft. high. These dimensions cover about the average limits. The ovens are arranged in blocks of 25 to 50 units, and a plant may consist of one or more blocks. The tendency is toward larger ovens which seem to be as efficient as smaller units.

Who's Who—in Coal Mining

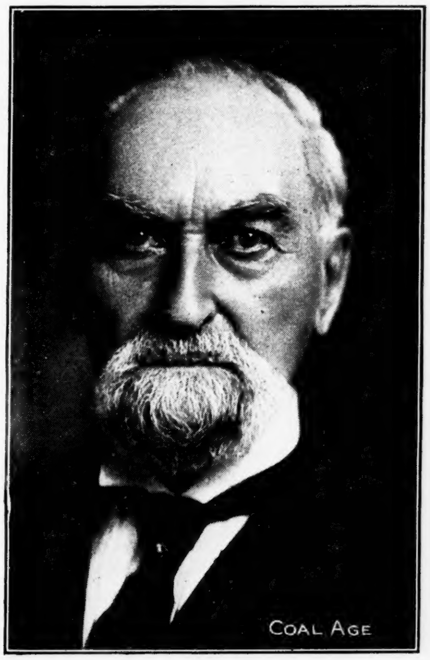
Devoted to Brief Sketches of Prominent Men, Their Work and Ideas

(This issue of COAL AGE *being devoted almost entirely to the subject of coke manufacture, it was deemed appropriate to publish herewith a sketch of the life of John Fulton, the venerable father of the coking business in America. His biography is one that needs no comment, since the highest eulogy we can render the man is a recital of his actual deeds.*—EDITOR.)

John Fulton was born in Drumard Cross, County Tyrone, Ulster, Ireland, Oct. 16, 1826. His ancestors were Scotch, but emigrated to Ulster during the movement to people the Province of Ulster with Scotch and English.

Mr. Fulton was educated in the Erasmus Smith High School, in Dungannon. In addition, he studied mathematics and English in the Ardtrea Classical Seminary, later taking up civil engineering in the city of Dublin, where he was employed during 1846 and 1847 on the location and construction of the Great Western R.R., from Dublin to Galway. During a portion of the year that followed, he was employed in the service of the English government on relief works in the County of Westfeath.

In the fall of 1848, John Fulton's father, the Rev. Thomas Fulton, concluded to emigrate to the United States of America with his family of six sons and one daughter, arriving in New York City in November, 1848. At this time there were only two railroads in process of construction, the N. Y. & Erie R.R. and the North River R.R. Mr. Fulton failed to find employment in New York and promptly concluded to seek it elsewhere; so with a small sum in his pocket he went to Wayne County, Penn., and was employed in that special branch of civil engineering where the chief instruments of the practitioner are a pick and shovel; the reward was a munificent salary of 75c. per day, out of which he had to board himself. The following spring he was promoted to the important position of "Boss," followed soon after by further advancement to the most exalted job of "Walking Boss," or Boss of Bosses! He continued in this work until the completion of the railroad from Honesdale to Hawley. After the road was constructed, he was transferred to the work of the completion of the North Branch Canal, under Contractor Francis Blair. His work here lasted from 1849 to 1852. In the canal work he was made boss of masonry, in addition to his other work, and built the large aqueduct at Tunkhannock, Penn. This brought him in frequent conference with Thomas T. Wierman, the engineer in charge of this section of the canal work. Mr. Wierman took some interest in young Fulton and subsequently invited him into the service. During the several years that he worked for Mr. Wierman he enjoyed the utmost confidence of this able and just man.



JOHN FULTON

From 1852 to 1854, John Fulton was assistant engineer in the construction of the Junction Canal, uniting the Pennsylvania Canal with the New York or Chemung Canal, from Athens to Elmira. In 1855, he was married to Miss Anne Mackay, in Arthur, Canada, the daughter of James Mackay, a Scotchman. During 1855, he was employed as assistant engineer under Mr. Wierman in the construction of a railroad about 18 miles in length, from Towanda to the Schrader Creek coal mines.

In 1856, Mr. Wierman was called to superintend the Huntingdon & Broad Top R.R., opening up the new Broad Top coal field, with headquarters at Huntingdon, Penn. Mr. Fulton was appointed resident and mining engineer, having charge of the maintenance of way of 60 miles of road and of the opening and development of the coal mines. He resided at Huntingdon one year and then moved to the more central town of Saxton. He spent sixteen years in this service, continuing to reside at Saxton with his family. During these years he came in frequent conference with the distinguished geologist, J. P. Lesley, forming a lifelong friendship. The Broad Top coal field affords the mining engineer one of the best schools for the study of structural geology.

During 1872 and 1873, Mr. Fulton was appointed by the Pennsylvania R.R. Co. chief engineer of the Bedford & Bridgeport R.R., from Mt. Dallas to Cumberland, but still retaining his position on the Broad Top railroad.

In 1875, "J. F." was invited to come to Johnstown by the Hon. Daniel J. Morrell, general manager of the Cambria Iron Co., and appointed general mining engineer, having charge of all the coal and iron-ore mines in Pennsylvania and Michigan. A wide variety of service was required in this department. Shortly after moving with his family to Johnstown, the blast furnaces were turned on to bessemer metal. Previous to this they were running mainly on native ores, producing a hard metal for the top of the rails from the carbonate iron ores of the coal measures.

A large coal washer supplied coal to a bank of Belgian coke ovens, but with Lake Superior iron ores, this coke proved insufficient to stand the stronger blast in smelting these ores. The bessemer-converter men got into a serious controversy with the furnacemen as to the latter's production of "cold metal." In this exigency, Mr. Morrell called Mr. Fulton to him and inquired: "What is the matter with our coke?" John modestly submitted that the superintendent of the blast furnaces was the party to determine this matter; however, Mr. Morrell insisted that the mining engineer should take up the problem at once and determine the trouble. At first sight, it appeared a moderately simple task—just have the home coke tested in the laboratory and compared with the Connellsville variety.

To Mr. Fulton's surprise, the native or home coke contained 5 per cent. ash and the Connellsville 10 per cent. ash. The real struggle was now on. Chemically, the home product was much cleaner than the Connellsville. It required a ten-days' serious investigation to find the difficulty in the home coke, but the analysis came at last. If the defect in the home coke was not in its chemical composition, it must be in its physical structure. Mr. Fulton reported to Mr. Morrell this fact

and suggested the immediate use of the Connellsville coke. The home article was too soft in body to stand the attack of the carbonic acid gases in its passage down the furnace. The washer and Belgian coke ovens were abandoned, Mr. Morrell ordering Connellsville coke, which immediately restored peace in the works.

Mr. Fulton continued his investigations on the qualities of coke as a bessemer blast-furnace fuel, writing a series of papers, which were published by the Foster Brothers, of Scranton, Penn., which finally grew into the first volume of "The Manufacture of Coke and the Saving of Byproducts," which was published by the International Textbook Co., in the year 1895.

Subsequently, Mr. Fulton made a tour of the Continent, studying in Germany and France, the methods of coke manufacture and the saving of byproducts, ammonia sulphate and tar, which, with all his home experiences, was published in a volume containing 500 pages, in the year 1905.

In 1887, Mr. Fulton was promoted to the general superintendency of the Cambria Iron Works. In 1888, he was further promoted to the office of general manager of these large works. In 1892, he had a serious attack of grippe; this, with other causes, lead him to lay down the worrying duties of general manager.

During his service of seventeen years with the Cambria Iron Co., he enjoyed the full confidence of Mr. Morrell and E. T. Townsend, the president.

After resting from the service of the Cambria Iron Co., he resumed the practice of his profession, civil and mining engineer. He was largely employed by A. J. Moxham, who established steel works at Johnstown, Penn., Lorain, Ohio, and in Nova Scotia. This service required Mr. Fulton to visit, examine and report on iron ores, coals, cokes and limestones in the different sections of the United States, Canada, Newfoundland and Puerto Rico. A few months later, he formed a partnership with Isaac Taylor, of Dunbar, purchasing about 80 acres of Connellsville coke lands on the Redstone branch of the Pennsylvania R.R. This partnership lasted about 12 years.

Mr. Fulton has taken considerable interest in sanitary matters, and for many years was a C. E. member of the State Board of Health, so ably manned by Dr. Benjamin Lee. During the year 1899, he was elected president of the state board. He was also a member of the State Forestry Commission of Pennsylvania, resigning in 1910, from the need of reduced service with increasing age. During the past year, he retired from the presidency of the Johnstown Board of Health, which he brought up to its present good standing. During the 10 years of his incumbency, Mr. Fulton insisted on the water company supplying the people of Johnstown with pure water, which they now enjoy.

During the closing years of the Second Pennsylvania Geological Survey, Professor Lesley, geologist in charge, wrote Mr. Fulton a pleading letter, saying that he had only $1100 left to make geological surveys of the counties of Cambria and Somerset, naïvely suggesting that as Mr. Fulton had much local knowledge concerning the geology of those counties, he might make ends meet. The miserable parsimony of the legislature cripples this most useful work in the full development of the mineral resources of the richly endowed State of Pennsylvania.

Mr. Fulton is a member of the American Philosophical Society, at Philadelphia, president of the City of Johnstown's Parks and Playgrounds Commission, and president of the Grand View Cemetery Association. He was a member of the committee on "Mines and Minerals," at the St. Louis Universal Exposition, in 1904, and received from Pres. David R. Francis two beautifully illustrated certificates and two medals.

One of these certificates reads:

—JOHN FULTON—

"In Recognition of His Secvices in Developing the Coke Industry in the United States."

During the year 1911, he retired from active field work and is now approaching his 87th year, and while he is occasionally complimented on his youthful appearance, he is aware that the evening shadows are deepening and that the call to the eternal world may come at any time.

Electromagnets for Coal Cleaning

A new departure in coal cleaning practice has recently been installed at a washing plant at Gelsenkirchen, Germany. This consists of electromagnets suspended over the screens for the purpose of separating any free particles of iron, such as broken pick points, pieces of rail, etc. It has been found that such foreign material in the coal often results disastrously to the crushers and this system has proved an effective remedy to such troubles.

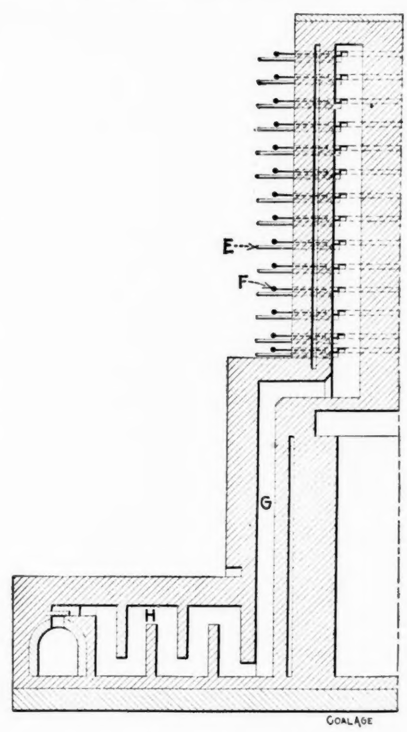
Earliest Use of Retort Ovens

Although the earliest record of an attempt to coke coal in closed retorts or furnaces dates back to about 1760, the work did not apparently take any definite form until 1855, when Dubochet, Knab and others operated plants with the saving of some byproducts. Shortly after this, Carves added side flues to Knab's design, and the byproduct oven in its essentials became a fact, "although it was not until 1881 that the condensation of ammonia and tar was a success along with the production of good coke.

A Vertical Coke Oven

The important feature of the oven shown in the accompanying figure is the shortening of the heating flues, with the object of securing more efficient action within the coking chambers.

The operation of this improved oven is as follows: The gas is supplied by the nozzles *E* at one end to the horizontally extending heating flues, and at the same time valves (operated by the handles *F*) are opened and heated air passes from the vertical supply passage *G* to the horizontal flues, the air being drawn from the regenerative chamber *H* which has previously been employed for



Cross-section of Vertical Ovens

the passage of the products of combustion and is therefore in a heated state. The products of combustion then pass through the horizontal heating flues in the side walls of the oven and at the opposite ends such products pass down the vertical flue which at this time acts as the exit flue. By way of this vertical flue the products of combustion pass to the regenerative chamber outside of the oven, which is not shown in the figure.

It will be noticed that when working in the above manner any horizontal flue can be thrown out, and this can be done without detrimentally affecting any of the other horizontal flues which it is desired to use.

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Of this issue of Coal Age, we will print 8000 copies. No copies will be sent free regularly. There will be no back numbers. The figures shown here each week represent live, net circulation.

This journal is interested solely in matters relating to the fuel industries, and is designed to be a medium for the free interchange of ideas, the detailed description of coal-mining practice, and the expression of independent thought calculated to benefit both operator and miner.

Contents

COAL AGE

A Good Opening for Capital

Conservation is being proclaimed in vain to the coal operator. He has been barely making both ends meet for many years, and he turns a sullen ear to every one who has a scheme which entails the expenditure of money.

The average mine superintendent does not travel. He has not seen much of his neighbor's plants. He promises himself that he will visit them some day, but he is afraid that if he does, something unforeseen will happen while he is away, some emergency will transpire and his subordinate will fail to meet the needs of the situation. He does not reflect that when he is dead, things will then have to worry along without him.

And thus it is that the average coke-oven man doubts and fears all innovations. He has not seen them, cannot weigh them, knows he is not fitted to advise as to their merits and may be unable to conduct the works if constructed. His apathy and his fears combine with the apprehensions and restrictions of capital and thus waste continues.

But here is the opportunity of the enterprising capitalist who knows what a byproduct or a heat-saving plant will do. Let him agree to build ovens and recovering houses in return for the byproducts from a certain number of tons of coal. After these have been delivered let it be arranged that the ovens, scrubbers, washers, saturators and stills become the property of the operating company.

Or let the capitalist offer to build and equip power houses and remodel ovens so that power may be generated by the waste heat of coking. Let him take as recompense for a determined number of years, the cost of providing power before the change was made. Then after the leasing years have passed let the operator own the plant.

By such arrangements the coke companies fighting against unequal odds will be able to bring their plants up to date. In many places, the life of the mines supplying the ovens is limited, and unless some development is soon made the opportunity will pass forever.

The plan we have outlined has been successfully inaugurated abroad and seems as if it could be practiced with advantage here. Who will grow rich by thus underwriting the risks incident to putting the coke industry on a modern footing? We cannot conceive a plan promising larger or more certain profits.

The Future of the Byproduct Oven

The American coke operator, in direct contradistinction to his foreign brethren, has not proved susceptible to the advantages and economies offered by the various byproduct processes. This may be ascribed partially to the necessity of a more rigid economy on the part of the foreign consumer, and in part to the high first cost of such installations as compared with the more popular and better known beehive oven. Doubtless a feeling of uncertainty as to the results obtainable, and the customary suspicion with which all revolutionary industrial enterprises are regarded, has also interfered seriously with the more universal adoption of byproduct ovens.

Not infrequently the assertion is heard that adequate markets are not available in which to dispose of the products. A cursory examination of statistics on this subject does not bear out such statements. Thus as regards the coal-tar products, toward which this assertion is principally directed, there are being imported into this country over eight million dollars worth of these products per annum as compared with a yield from our ovens of only slightly over one and one-half million. And, further, the figures for these imports are based on the value at the point of shipment, so that the ultimate cost to the consumer here has been conservatively placed at 14 million dollars, or, roughly, ten times the value of our production.

It is generally conceded that the different compounds and combinations of ammonia would find a stable and practically unlimited market. And as regards the byproduct gases, which have a value of one-third the total, there is an unlimited demand for these at any large consuming center. It has also been estimated that were the total coke production of the country manufactured in byproduct ovens, there would be a gas yield of one million horsepower per hour for each day in the year. We commend this feature to the careful consideration of the conservationist.

The byproduct oven is indubitably an established fact and the next few years will no doubt see a more general adoption of it, together with a more favorable acceptance of the principles of economy for which it stands.

Why Coals Vary

Vivian B. Lewes, the author of the articles on "Why Some Coals Coke," published in this issue, is a leading English authority on that subject—a preëminence he has held for over twenty years. His article brings out a great number of interesting facts on the varied nature of the bodies composing coal.

The organic compounds in carbonaceous bodies are broadly divisible into three general types, namely, resins, humus bodies and hydrocarbons, which are probably derivative from the first two. By solvents, these different constituents are thought to be separated from the coal and their variant characteristics determined.

The resinous bodies are remarkably resistant to decay, and owing to that property serve to prevent the humus compounds from splitting up into methane, carbon dioxide and water, as is their tendency. Probably in early vegetation, resins were more preponderantly found than they are today. We can be sure that the peat masses, when heated, gained in percentage of resin, because the less stable humic bodies decomposed and passed away in gaseous form. Thus the resinic bodies in coal are usually in excess of the humus constituents.

The resinous bodies are rich in carbon, hydrogen and oxygen, with the first constituent in large excess, and with the oxygen in about equal proportion with the hydrogen. The humus bodies, which perhaps are not definite compounds, resemble the resins in the percentage of carbon, but their oxygen content is about seven times as great as the hydrogen.

It will be readily understood that when the embalming resins do not thoroughly incase the humus corpses, the dissolution of the latter must speedily follow. Consequently, if the resins, the gluing constituents of coal, are not well distributed, the lignite formed will be weak. If the temperature to which the coal is exposed is high, only the resins will be left, and a higher intensity of heat will break up even these.

Interesting is the view that these resins are the cause of the coking action of coal; that they form the pitch which lutes the coke, and that when the pitch is carbonized, it makes the strong bond characteristic of good coke. But this and all other views must be accepted with reserve. It is not inconceivable that the body which causes caking may be entirely different from that which gives coke its strength, though the fact that the crushing of coked coal destroys its ability to cohere when further heated makes the suggested cause quite probable.

However, the action of the ash is worthy of consideration. The final change in the resin from pitch to carbon is so large that it is difficult to believe that the change in condition takes place without a weakening of the bond. We would almost rather believe that the cause is an incipient dehydration of the ash, followed at higher temperatures by a further loss of water, just as a weak salmon-colored brick becomes a brick with a metallic ring under similar heat action.

It has been noted that some of our strongest coking coals have a large percentage of ash, throughout the coal body. But all coking problems are matters for discussion rather than for arrogant dogmatism; so little has science done toward placing the study on safe ground.

The remarks on the relations of resins to spontaneous combustion are equally subject to criticism. Mr. Lewes believes that the resin of the coal takes up oxygen and the adsorption causes the coal to heat to such an extent that it will burn whenever the passage of heat from the coal is not rapid enough to make such a result impossible.

The theory is not new, but if oxygen in the air-dried samples of coal is a sign of the presence of humus constituents, it will be found that the coals most liable to spontaneous combustion contain the largest amount of humic bodies. But according to Mr. Lewes, resinic coals which have but little oxygen should be the most likely to inflame without external aid.

His theory places itself squarely across the facts and can only be saved by saying that when the resins have created the heat, the humus bodies may provide the ready tinder by which the conflagration can be spread. Lacking the tinder, no action can take place. Mr. Lewes does not make this remark; probably it is not true, and in that case there is no vital force in the contention that resin is the cause of spontaneous combustion.

The Georges Creek coal, which will not fire spontaneously, is found after air drying to contain about 3 per cent. of oxygen. On the other hand, coals which ignite from their own heat contain 12 per cent. of that element when air dried. Lignites contain even more, and they are still more subject to spontaneous combustion.

If it be a permissible assumption to regard the excess of oxygen of the Illinois coal over that of Maryland as due wholly to the presence of humus bodies in the coal, humic acid, for instance, then the fuel from the Western state would have 27 per cent. more of that acid than the coal from the Eastern, where the uplift of the Appalachian chain has devolatilized the fuel.

From these considerations we are led to the belief that the relative proportion of humus bodies is more important than the comparative quantities of resin, and we feel sure that the "resinic appetite" awakened after eons of an oxygen drought is not the hidden cause of so many goodly colliers being swallowed by the "great deep."

If we were choosing the coal wherewith to load a ship and desired to insure ourselves against loss by fire, we would try to eliminate not resin but humus bodies, and we might use the presence or absence of oxygen in the air-dried sample as a means of proving whether the humus bodies still remained in the fuel. Associated with the humus, if not part of it, is a sulphur, which is driven off at low temperatures. This is likely to be the real heating agent. A determination of that sulphur would probably serve a useful end. Nothing could be learned from the resin, for apparently the more resin, the less risk of spontaneous ignition.

Discussion by Readers

Comment, Criticism and Debate upon Previous Articles, and Letters from Practical Men

Humidity of Mine Air

Replying to the comments of James Ashworth, on pp. 17 and 18, COAL AGE, July 6, referring to my paper read before the West Virginia Coal Mining Institute, and published on pp. 1177 and 1178, COAL AGE, June 15, permit me to say the article had been prepared, mainly, from observations in West Virginia mines, and for the purpose of agitating this subject; so that authors on mining, such as James Ashworth and others, might interest themselves and give their opinion on this important matter. As requested by Mr. Ashworth, I will endeavor to make clear the points in question, relative to temperature and humidity.

Please note, on p. 1178, in my opinion, 55 deg. F. is a healthy temperature for miners to work in. At that temperature air is capable of absorbing, to the point of maximum saturation, 4.97 grains per cu.ft. of water, which is equal to 8.3 gal. of water per 100,000 cu.ft. of air. In practice, during the colder season of the year, in West Virginia mines, this amount of moisture is slightly insufficient to keep the coal dust wet. But, when the mine air has been tempered, to an extent that it contains from 94 to 100 per cent. of humidity at 59 to 60 deg. F., coal dust and all combustible material can be kept wet, and the atmosphere feels comfortable for miners to work in. If the temperature is allowed to reach about 63 or 64 deg. F., the air at full saturation feels overheated. In my opinion, from a standpoint of health, and safety to life and property, 5.82 grains per cu.ft. of water, which equals 9.843 gal. of water per 100,000 cu.ft. of air, is an insufficient amount for mine air having a temperature of 90 deg. F., as under those conditions air would be classified between "dry" and "very dry."

It has been observed that, in mines, there is a much larger amount of organic matter in the air at 90 deg. F. than there would be at 60 deg. F., due to decaying matter, etc., which would continue to float in the air unless exposed to air in free motion and fully saturated, or nearly so with moisture. Mine air at 90 deg. F., fully saturated, is oppressive; but much of the organic matter is dissolved when the dew point is reached, and a miner's health, in my opinion, would be considerably prolonged in a mine temperature of 90 deg. F., when the air has been thoroughly cleansed of the coal dust and germs, in comparison with mine air at 90 deg. F., which has not undergone this cleansing process. Air, when saturated at 90 deg. F., contains 14.38 grains per cu.ft., or 25.439 gal. of water per 100,000 cu.ft. of air. This weight of water in mine air would probably not agree with many miners, and an operator could not expect a fair day's work from them. In mines where the temperature approaches 90 deg. F., the air should be tempered, at least before it enters the working places; and the same should be done when the temperature falls below 57 deg. F.; otherwise we are not making the much needed progress for the prevention of disasters to life and property. I hope that I have made this matter clear.

KARL F. SCHOEW,
Mine Inspector, First District.
Fairmont, W. Va.

Experience of a Fireboss in a Gaseous Slope

The slope was driven all the way in the coal. The seam dipped 25 deg. and the coal varied from 5 to 8 ft. in thickness. The crosscuts were 21 ft. long and driven 40 ft. apart, center to center, measured on the slope. The last crosscut at the head of the slope was in the full length; but the main return air course was only up 30 ft. from the preceding crosscut, and had not as yet holed through to the crosscut above. The return air courses on each side of the slope, respectively, had shown considerable gas and slight explosions had at times taken place.

On this occasion, the fireboss found the 30 ft. of return air course above the last open crosscut full of gas. He also found the crosscut at the head of the slope full of gas. The lamp used for testing for gas was a No. 6 Clanny; the flame was turned down to the high blue. The gas cap was peculiar, yellow on one side and a pale blue on the other, these colors uniting about one inch above the lamp flame. Scarcely had the cap been observed when the lamp flamed and then flashed, the flame showing more yellow than blue. The fireboss supposed he was in a body of mixed gases and assumed that the yellow color was due to sulphureted hydrogen and the pale blue color to light carbureted hydrogen.

Leaving his lamp on the main slope the fireboss went again into this body of gas about 30 ft. to listen for a knock from the crosscut above. He remained, as he thought, about two minutes in the gas and came out to where he had left his lamp. Immediately on reaching the fresh air he became unconscious and fell. A miner close by, who ran to his assistance, said that the fireboss was unconscious for at least twenty minutes, and it was one hour before he was taken out of the mine. He recovered slowly from the effects of the gas and it was five hours before he could bend his knees sufficiently to wash his face, owing to the deadly sickness that took possession of him.

I have had personal experience with nearly all mine gases, such as whitedamp, blackdamp, firedamp and afterdamp, and am familiar with their effects upon the human system. It seems to me, however, that this last experience differs from them all. The effect of whitedamp, as I have observed it, is to cause the nose to run water; the eyes become enlarged and have a fixed stare.

A heavy body of blackdamp makes a man snore in five minutes and in ten or fifteen minutes you can hardly wake him. If left for thirty minutes it will probably be his last sleep. I believe there is little or no pain.

In case of an explosion the miner often inhales flame; or he must breathe hot air and gases, or perhaps no air at all. This is called the afterdamp of the explosion and is composed largely, I believe, of nitrogen and blackdamp.

My reason for writing this letter is to get information for myself and others as to the nature of the combined gases mentioned. Some readers of COAL AGE have probably had a similar experience in gas and can give information that will probably be the means of saving many lives. I want to say I appreciate very much the value of discussion.

GEO. T. MAIN.
Republic, Ala.

The value of the byproducts from retort coke ovens during the year 1910 was \$8,479,557, or a little over one-third the value of the coke produced, which was \$24,793,016. The byproducts consisted of 66,303,214 gallons of tar, valued at \$1,599,453; 70,247,543 lb. of ammonium sulphate, valued at \$1,841,062; 27,692,858 cu.ft. of sulphur gas, valued at \$3,017,908; 20,229,421 lb. of anhydrous ammonia, valued at \$1,725,266; 4,654,282 gal. of ammonia liquor, valued at \$295,868.

Inquiries of General Interest

Questions are not answered unless accompanied by the name and address of the inquirer. This page is for you when stuck—use it

Relative Heating Values of Coal and Coke

The following is the proximate analysis of a certain coal: Moisture, 1.2 per cent.; volatile matter, 26.4 per cent.; fixed carbon, 63.4 per cent.; ash, 8.4 per cent.; sulphur, 0.6 per cent. Experiments have shown this coal to have a heating value of 10,200 B.t.u. It is desired to know: (a) What percentage of coke may be expected from this coal? (b) If this coal can be laid down, at a certain factory, at $7.50 per ton and the price of the coke laid down is $9.50 per ton, will it be cheaper to use coal or coke at this factory for fuel?

ENGINEER.

New York City.

In the operation of coking, the volatile matter, including moisture and sulphur, are driven off, and what remains in the coke is the fixed carbon and ash. The theoretical yield of coke from this coal would be 63.4 + 8.4 = 71.8 per cent. This assumes that all the fixed carbon remains in the coke. There is always a certain loss of carbon, however, which is burned, and on this account the actual yield of coke, in this case, will not exceed, say, 70 per cent. It is impossible to wholly avoid this loss of carbon as it is necessary to admit air to the oven during the first stage of the process.

(b) Since all the ash and part of the carbon is contained in the coke, which is 70 per cent. of the original weight of coal, the percentage of fixed carbon in the coke is

$$\frac{70 - 8.4}{70} \times 100 = 88 \textit{ per cent.}$$

The heating value of fixed carbon is 14,540 B.t.u. per lb. Now, comparing the heating values of the coal and the coke, we have:

Heating value of coal,

$$\frac{10,200 \times 2000}{7.50} = 2,720,000 \textit{ B.t.u. per ton}$$

Heating value of coke,

$$\frac{0.88 \times 2000 \times 14,540}{9.50}$$

$$= 2,693,000 \textit{ B.t.u. per ton}$$

These results show the number of heat units of the coal and coke, respectively, that can be purchased for one dollar at the factory. The figures show a surplus of 27,000 B.t.u., in favor of the coal.

Heating Value of Coal as Calculated from Analysis

Is it possible to determine from the analysis of a coal its approximate heating value with any degree of accuracy? Which of the following analyses of coal will show the greatest heating value:

Carbon	76.2	65.2
Hydrogen	5.6	6.0
Oxygen	10.4	21.6
Sulphur	1.2	0.9
Ash	6.6	6.3
	100.0	100.0

MINE SUPERINTENDENT.

Denver, Colo.

It is customary to calculate the heating value of a coal from its ultimate analysis by the use of Du Long's formula; thus,

Heating value per lb. of coal,

$$146\,C + 620\left(H - \frac{O}{8}\right)$$

where C = carbon, H = hydrogen, O = oxygen.

The heating value of the first coal given above, as calculated by the formula, is

$$\textit{Heating value} = 146 \times 76.2 +$$

$$620\left(5.6 - \frac{10.4}{8}\right) = 13,791 \textit{ B.t.u.}$$

The heating value of the second coal, calculated by the same formula, is

$$\textit{Heating value} = 146 \times 65.2 +$$

$$620\left(6 - \frac{21.6}{8}\right) = 11,565 \textit{ B.t.u.}$$

It is claimed the use of this formula gives the heating value of coal within less than 2 per cent. of error.

Energy of Coal

What is meant by the energy stored in a pound of coal?

INQUIRER.

Lexington, Ky.

The energy stored in a pound of coal is found by multiplying the heat value of the coal (B.t.u. per lb.) by the mechanical equivalent of the heat; namely, 1 B.t.u. equals 778 ft.-lb. This gives the foot-pounds of energy that may be developed, theoretically, in burning 1 lb. of coal, or the stored energy per pound of coal. Dividing this by 2000 gives the energy in foot-tons. Thus, the stored energy in a pound of coal having 12,300 B.t.u. is

$$\frac{12,300 \times 778}{2000} = 4784 \textit{ foot-tons}$$

Weight of Coal Burned per Horsepower, per Hour

What weight of coal is it fair to assume must be burned under the boilers to develop 100 hp. and what is the efficiency of the coal in this case?

Victoria, B. C., Can. A. D. T.

Assuming the coal contains 90 per cent. fixed carbon, or has a heat value of 14,500 × 0.90 = say, 13,000 B.t.u. per pound of coal, the theoretical energy of the coal is

$$\frac{13,000 \times 778}{2000} = 10,114,000 \textit{ ft.-lb.}$$

Then since 1 hp. is equivalent to 33,000 ft.-lb. per minute, the theoretical weight of coal that must be burned per hour to develop 100 hp., is

$$\frac{100 \times 33,000 \times 60}{10,114,000} = 19.5 \textit{ lb.}$$

say 20 lb. per hour.

In the operation of an ordinary cylindrical flue boiler burning bituminous coal, it is common practice to allow from 3 to 3.5 lb. of coal burned per horsepower per hour. On this basis, to develop 100 hp. would require burning 3 × 100, or 300 lb. of coal per hour.

In this case, the efficiency of the coal burned under the boiler would be

$$\frac{20 \times 100}{300} = 6.6 \textit{ per cent.}$$

West Virginia as a Producer of Coke

I am aware that a good quality of coke is produced in the Pocahontas and New River fields of southern West Virginia, but I would like to know whether any coke is manufactured at the mines in the northern part of the state. What is the sulphur content?

H. J. LAWRENCE.

Pittsburgh, Penn.

There are a large number of veins of coal in the northern section of West Virginia from which coke is made. The highest-grade cokes are made at plants located on the Morgantown & Kingwood R.R., in Preston County, and along the line of the Western Maryland. The products of these various plants are, as a rule, under 1 per cent. in sulphur; in fact, they very often analyze as low as 0.75 per cent. The ash, however, is usually over 12 per cent., often running as high as 13.50 to 14 per cent. The coke is hard and large, but is considerably lighter in weight than Connellsville coke.

Examination Questions

Selected from State Examinations, or Suggested by Correspondents

Selected Questions on Coke and the Coking of Coal

Note—The present issue of Coal Age being devoted wholly to the subject of coke and the coking of coal, the following questions have been selected and are answered here, because of the growing need of this knowledge on the part of mine foremen and the probabilities that questions of this nature may soon be asked in examination:

Ques.—What is coke?

Ans.—Coke is the solid product, consisting chiefly of the fixed carbon that remains when certain coals are subjected to heat in a kiln or oven from which the air is more or less completely excluded.

Ques.—What is the general composition of coke and to what uses is it applied?

Ans.—A good quality of coke consists of from 85 to 90% fixed carbon, the remainder being ash with a small percentage of unburned volatile matter and a varying amount of impurities that were contained in the original coal and not wholly removed by washing before the process of coking was begun. By far the larger portion of all the coke manufactured is used in blast, furnaces and in foundries. Coke is also used to some extent in the manufacture of producer gas. To a limited extent it is used in the industries and for domestic purposes and wherever a smokeless fuel is required.

Ques.—Name some of the advantages and disadvantages of the use of coke in place of coal.

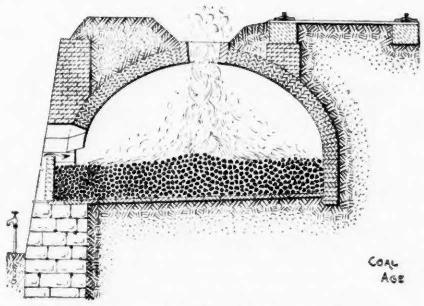
Ans.—The principle advantages are the following: It is a clean fuel that produces no smoke in burning, and gives a concentrated heat that is of great use for certain purposes. Under forced blast there is less fuel loss than in burning coal. There is less loss in storage, as coke is not materially affected by the weather. The chief disadvantage of coke is its bulk. Much more space is required for storing the same weight of fuel, and special cars are needed for its transportation; and these must, as a rule, be returned empty.

Ques.—Name the two principal methods of coke manufacture, and describe briefly the difference between them.

Ans.—The two principal means in use for the manufacture of coke are (1) the beehive oven, (2) the byproduct-coke oven. The chief difference between these two methods consists in the treatment of the volatile matter distilled from the coal. In the beehive oven these volatile matters are all allowed to escape into the atmosphere, producing a large quantity of smoke, which is objectionable in closely settled regions, to say nothing of the waste of valuable products. The byproduct-coke oven is designed to save all the volatile matters, thus avoiding the smoke nuisance and converting the waste products into useful material.

Ques.—Show by sketch the general form of standard American beehive oven.

Ans.—The accompanying figure shows in cross-section the general features of a beehive coke oven with the charging



CROSS-SECTION OF BEEHIVE OVEN

track above and the opening through which the oven is charged and the waste products escape. The coke is drawn through the small opening shown on the left below the springing line of the arch or dome.

Ques.—What treatment does the coal receive before charging into a coke oven?

Ans.—While in some instances coal is charged into the ovens just as it comes from the mines, without special preparation, the quality of the resulting coke is much improved by treating the coal according to its character, to remove any impurities it may contain and to reduce the product to a uniform size. When the coal contains sulphur or phosphorus it is necessary, for most purposes, to remove these impurities as far as possible by washing the coal. When a fine quality of coke is required the coal is crushed to a moderate degree of fineness before charging. Water is often used to dampen the coal before charging into the oven, which dampening it is claimed facilitates the charging process. For blast-furnace use, coke should not contain over 1.2 per cent. of sulphur or 0.03 per cent. of phosphorus, as these impurities injure the quality of the iron produced. Coke giving a large quantity of ash has a lower calorific value, and is more easily crushed.

Ques.—(a) Will all coal yield coke when heated in a closed oven, and is it possible to determine a coking coal without making an actual test? (b) What is the general principle on which the coking of coal depends?

Ans.—(a) No. The property of coking is possessed only by certain coals. It is not possible to determine positively the coking character of a coal from its analysis, or by any other means than by an actual practical test. (b) In the first stages of coking, the increase of heat is gradual and the volatile matter of the coal escapes. In this stage sufficient air is allowed to enter the oven to maintain incomplete combustion and insure a sufficient development of heat to sustain the action. As the volatile matter escapes the coal swells and the bituminous matter it contains fuses, forming a more or less pasty mass. At a certain stage of the process, the air is shut off by closing the doors of the oven, sealing the opening tight with clay. The heat developed in the oven during this latter stage converts the coal into a hard, vitreous mass. This product is allowed to cool a short time and later is drawn from the oven and quenched with water.

Ques.—What weight of coke may be expected from one ton of coal having the following analysis: Moisture, 1.5 per cent.; volatile matter, 32.4 per cent.; carbon, 58.6 per cent.; ash, 6.6 per cent.; sulphur, 0.9 per cent.?

Ans.—The theoretical yield of a coal, in coke, is obtained from its proximate analysis by adding together the fixed carbon and ash; thus, in this case, the theoretical yield in coke would be $58.6 + 6.6 = 65.2$ per cent. In the beehive oven the yield will often be somewhat less than the theoretical amount, owing to the burning of some of the carbon during the coking of the coal.

Ques.—What is the general appearance of a good quality of coke?

Ans.—A good quality of coke is a hard porous substance having a metallic ring and a gray silvery luster.

Ques.—What is the weight per cubic foot of an average quality of coke and what space will be occupied by one ton of coke piled loose?

Ans.—The weight of coke varies considerably, according to the quality of the coal from which it is produced. An average value is about 27.5 lb. per cu.ft. When piled loose, coke will occupy anywhere from 70 to 90 cu.ft. per ton, according to the density of the coke.

Sociological Department

For the Betterment of Living Conditions in Mining Communities

Licenses to Mine Coal

By Jonathan M. Wainwright*

In considering industrial accidents, it is well to remember that workmen's compensation acts will come into force in every state sooner or later. As time goes on, the tendency will be to make more and more liberal provision for people injured while engaged in industrial labor. We should remember also that the burden of workmen's compensation is going to fall ultimately on the public and not on the individual employer of industry.

When it is so arranged that any industry will have to provide for its injured, the price of the product will have to be adjusted to meet this new condition, so that this question really is one between the working people and the general public. It is not simply a matter affecting only working people and their immediate employers. Therefore, if the public is to take up this new burden, it is quite important that it should consider thoroughly two propositions, first, how to prevent industrial accidents and, second, after an accident has occurred, how to make the results as slight as possible. Only the first problem will be considered in this paper.

Unnecessary Accidents

We can find any number of examples which will serve as excellent texts from which to discuss the first problem—how to prevent industrial accidents. To take a recent example, in a coal mine near Scranton a miner had prepared his blast ready for firing. It is a standing rule in coal mines that a miner shall call out a warning before setting off a blast. In this particular case there were two other men working independently, close to the miner who was ready to fire. He did not call any warning at all but fired his blast, with the result that the two men working nearby received its full force. One of the men was killed and the other had the sight of both eyes destroyed and was so severely injured in other ways that while he will continue to live it is doubtful if his condition is much preferable to that of the man who died.

Here we have an incident in which one man was killed and another hopelessly maimed for life, because a third did not take the trouble to call out a warning before firing a blast. This is an illustration of the fatal accidents which are due to absolutely inexcusable carelessness and which no amount of superintendence or instruction can prevent. Everyone who views the question of industrial accidents at close range knows that much the larger number are due to inexcusable carelessness either on the part of the victim himself or of someone working with him. Nothing will make any very marked reduction in the number of industrial accidents until more efficient means are adopted to eliminate pure carelessness.

The Public Should Have a Recourse against the Careless

It is true that safety devices will help somewhat but even these can rarely be made "fool proof." Moreover the instruction of employees will help to a certain extent, but after all in the great majority of cases it is not the new and green men who are careless and thus are subject to accidents. The new men are afraid to do the fool tricks. It is the old hands whose constant familiarity with their work has bred contempt for danger and has led them to neglect the safer way of working in order to save themselves a little time or trouble. No one will question the fact that if the public is to pay for all these accidents of carelessness it has the right and is able by virtue of its police power to adopt any regulation which will eliminate carelessness so far as is possible.

A Miner's License

I believe that the only way that any serious impression can be made on the number of accidents which arise from carelessness is for state boards or commissions of some kind to license all operatives who are engaged in dangerous trades or who work in positions where the safety of other people depends upon their carefulness. These commissions should have the power to withdraw at once the license of any individual who neglects the proper safety precautions, whether such neglect is followed by accident or not. The majority of injuries in the coal mines are due to carelessness or the neglect of some of the prescribed rules for safety and are, therefore, avoidable. Undoubtedly many people will not believe this statement but they deny it only because they have not a personal knowledge of the facts.

Under conditions as they are at present, mine workers are constantly neglecting the safer methods simply because such precautions take a little more time and trouble. Fortunately a great many of these cases of neglect of the rules of safety are not followed by accidents. However, there is hardly a day goes by in the coal regions when someone is not badly hurt, because he or some of his neighbors have not taken the time and trouble to avoid the injury. It is absolutely impossible under present conditions for superintendents, etc., to insist rigidly upon the rules of safety. If a man is discharged for violating a safety rule, the only result in all probability will be a strike by all the other men in the mine, and discipline and the rules of safety can only be enforced if their infraction has been followed by fatal or serious result.

After all, the question is largely one of human nature. We all do foolish or even dangerous things every day though we know well what the possible results may be. But these foreseeable results (even if they involve the maiming or the death of ourselves or our friends) are after all so remote that we do not pay much attention to them. We may grant, therefore, that the mine workers are constantly neglecting the rules of safety and are using in their work simpler short cuts which lead to danger. Yet they are not at all disturbed by any presentiment of misfortune, and under present conditions will continue their carelessness indefinitely.

However, suppose we had a law by which the miner was licensed and that we had a corps of state inspectors who could take his license away where the inspector found him guilty of any careless or dangerous practice, then an entirely new condition would be found. If the miner knew that at any moment a state inspector might pounce in upon him while working under an unprotected roof, for instance, and take his license away from him forever, and say, "No more mining for you; get some other job," the miner would pay vastly more attention to the rules of safety than he does at present.

Fear of Punishment More Keen Than That of Death

This also is another part of human nature. Without hesitation, we will all of us at times do things which will endanger our lives, merely to save a few minutes. However, if this same practice might result in the loss of our occupation or even in the waste of a few hours' time we would not think of doing it. For instance, any man if he is in a hurry will jump

*Chief surgeon, Moses Taylor Hospital, Scranton, Penn.

on a moving street car rather than wait a few minutes to take the next one, and he will jump off rather than be carried past one block. He will always continue to do this if he knows that the result is only going to be, perhaps, a broken leg or some more or less severe physical injury. However, if there was a law against jumping off street cars and he knew that the traffic policeman on the corner would arrest him as soon as he landed, walk him to the police station and lock him up till he could obtain bail he would stop the practice at once.

Licensing is a Well Recognized Practice

The right of society to license certain industrial classes under the theory that if they endanger others their license should be taken away is not new. Automobile drivers or owners are all licensed now but unfortunately the practice of taking away running rights from men who endanger the public, while generally approved, is but rarely carried out. Yet the whole question of the prevention of our present serious number of automobile accidents lies right here. If the police should begin to take away, once and for all, the licenses of every automobile owner or driver who breaks the traffic regulations, automobile accidents would practically cease at once. A chauffeur would not drive through the city streets at the rate of 30 or 40 miles an hour if he knew that if detected in this, once, he might never again be allowed to drive an automobile. Our present conditions are due to the fact that violators of the traffic laws have no fear that they will lose their licenses permanently and will be compelled to seek other occupations. The danger of a possible fatal accident to the chauffeur and his passengers, or to pedestrians, is a negligible factor in preventing automobile accidents.

The Employer Is Asked to Sustain the Burden of Discipline

The need of a system by which those engaged in a certain occupation can be licensed and these licenses revoked permanently if the individual neglects the rules of safety is illustrated forcibly by the conditions surrounding the employment of railway trainmen. No one who has read Mr. Fagan's articles can deny that it is impossible for railway officials to maintain discipline and enforce rules for the safe operation of trains so long as the attitude of their unions remains as it is.

A large number of irregularities in train operations are caused by the fact that the men operating the trains do not obey the prescribed rules and signals. The failure to obey some of these rules is an every-day occurrence in the United States, but of course fortunately in most cases disobedience to rules does not result in an accident in which people are injured. We will have to admit, therefore, that present conditions do not compel trainmen to exercise the care for the travelling public that the conditions demand.

The system which we are advocating is the only one we believe will attack this condition. If all trainmen were licensed and they knew that state or government officials might at any time appear on their track or in their trains to observe whether they were obedient to the rules of safety, and if these officials had power to revoke licenses and could permanently oust an individual from the railroad service, the question of neglect of safety rules would be settled in direct proportion to the efficiency of the state or government inspection. A system such as this would meet with a great deal of opposition on the part of the employees themselves, yet the only reason they could give for opposing it would be that they wished to continue the present conditions by which they can through carelessness jeopardize with impunity the lives or property entrusted to them.

Discipline Should Have Support of the Body Disciflined

Yet the same system and theory apply to physicians and no one is more zealous in their enforcement than the physicians themselves. At the present time in nearly every state in the union a physician must be licensed before he can practice medicine and these licenses can be taken away if the boards granting them are convinced that for any reason it is dangerous to have a given physician continue in practice.

Physicians' licenses, perhaps, are not revoked nearly so frequently as they should be, but that is another matter. If a physician can be licensed and his license can be revoked for cause, permanently barring him from practice in the state, why should not the same priciple be applied to engineers? The number of lives placed every day in the hands of these men is many times greater than are entrusted to the medical profession.

In all the foregoing, the principle we have maintained is that the mere prospect of physical danger or even death has practically no effect in compelling people to avoid dangerous practices. And on the other hand the prospect of an arrest with its ordinary inconveniences and a fine, but most of all with the withdrawal of a license without which one cannot follow one's occupation, is the only possible means of influencing this particular weakness in human nature. A very good illustration of this theory is furnished by the enormous number of deaths each year among trespassers on railroad property.

To sum up this whole question we would say, first, the compensation for accidents, whether industrial or otherwise, will have to be paid by the general public. Second, if the public assumes this function it must also pass every reasonable law and exercise every reasonable police power to prevent people from following dangerous or careless practices which by any possibility may result in an accident to themselves or other people. Third, prevention of accidents in this way, even if it does require numerous corps of inspectors will be much cheaper than paying for accidents where no such supervision is maintained and where the right to kill or maim oneself or one's fellow workmen is part of "the American standard of living."

First Aid Day at Ellsworth

Thursday, July 11, was observed as First-Aid Day by the miners of the Ellsworth Collieries Co., at Ellsworth, Penn. The afternoon was devoted to a most interesting demonstration of first-aid work.

Seventeen teams participated, representing the Nos. 1 and 2 collieries of Ellsworth, and the No. 3 colliery of Cokeburg. Each team consisted of a captain, a patient and four men trained in first aid. All of those who took part toed a chalk line drawn across the baseball field, and as the various signals were given, the respective teams sprang into position, and in a remarkably short space of time administered first aid to patients supposed to be suffering from the following injuries.

1. Cut over left eye.
2. Broken left upper arm.
3. Back burned by electric wire, necessitating artificial respiration.
4. Broken jaw, crushed foot and broken rib.

Along one side of the field was erected a frame structure 100 ft. in length, covered with brattice cloth and representing a mine entry. The final event consisted in rescuing a man from the tunnel after a supposed explosion. Black powder was ignited in the tunnel, and when the resulting smoke enveloped the entire structure, the four expert helmet men of the Ellsworth Collieries Co., equipped with Draeger breathing apparatus and carrying a stretcher, rushed in and effected the rescue. The injured man was carried out of the smoke, given first aid, including the use of the pulmotor, and finally lifted into the company ambulance and driven away at high speed.

The demonstration was intensely interesting and instructive, and was witnessed by a large and sympathetic audience. The men who took part are worthy of commendation for the snap and precision with which they performed their work, and to Mr. E. E. Bach, social superintendent of the Ellsworth Collieries Co., belongs the credit of training the teams and directing the successful exhibition.

Coal and Coke News

From Our Own Representatives in Various Important Mining Centers

Washington, D. C.

The Interstate Commerce Commission has handed down decisions relative to the case of St. Louis Blast Furnace Company vs. Virginia Railway Company, dealing with the question of the rates charged upon shipments of coke from points in West Virginia and Pennsylvania to points in Missouri. The Commission finds that the rates were not unjust in themselves although in certain cases the rates actually collected were in excess of the rate lawfully on file and hence a reparation of the difference between the lawful rate and that which was filed with the Commission is allowed.

The decision in this case is of considerable interest when viewed in connection with the earlier coke rates of the Commission. On June 19, 1911, the Commission issued a report and orders for reparation and unreasonable rates, but the order was not obeyed and the case was taken to the Commerce Court. Subsequently the petition in the case was dismissed and a rehearing granted. The subject is now brought up afresh. In this case, the defendants complain of the findings in the former report on various grounds. These the commission rejects, but with reference to the general question it says:

The complainant asks that reasonable rates be fixed for the transportation of coke for the future. We did not prescribe any future rate in our prior report, nor are we inclined to do so on the present record. In other proceedings now pending rates on coke are under investigation. If whatever action the Commission may take in these proceedings requires a consideration of the rates involved in the instant cases, such matters will be attended to at the proper time. Our present findings are restricted to the overcharges exacted of the complainant and are based upon the grounds set forth. In taking this course we are not unmindful that defendants based their petition in the Commerce Court, in part, upon the ground that we have no authority to award reparation without fixing the rate for the future, saying:

The Commission did not, however, in either of said orders, or in its report, undertake to ascertain or fix a maximum reasonable rate to be observed in the future, nor did the Commission order any other or any new rate into effect, but simply awarded reparation to the complainant. Your petitioners allege that the said orders of reparation, without the establishment and prescription of a maximum rate to be observed in the future, are beyond the power of the Commission; that the Commission was without jurisdiction or authority to award reparation in this manner, and that the finding and prescription by the Commission of a reasonable maximum rate to be observed by all, the ordering by the Commission of such a rate, and an order by the Commission prohibiting the use of a rate in excess thereof, are conditions precedent to an exercise of the powers of the Commission to order reparation.

Without commenting upon the reasoning upon which this objection was based, we desire to call attention to the fact that our awards of reparation are based upon the determination that the complainant is entitled to an award of damages, under the provisions of the act to regulate commerce, for violations thereof in the past, not for present violations thereof, and that this report and the present orders are based not upon the unreasonableness per se of the rates and charges collected of complainants, but upon the exactions of rates and charges in excess of the rates and charges lawfully applicable to the shipments in question.

In the case of the C. W. Hull Company vs. The Southern Railway Company it is held that the deduction for moisture from the net weight of coal does not constitute the remainder as net weight but is merely an arbitrary basis upon which to compute charges. The tariffs of the Southern and other connecting roads have contained the following provision: "Rule 8. On shipments of washed coal, deductions for moisture from the actual net weight as ascertained on track scales at point of shipment will be made. The maximum deductions that will be allowed are as follows: No. 1 egg coal, 1 per cent. No deductions will be allowed if weighed enroute or at destination. Agents at billing points will show gross, tare, and net weights and deductions for moisture on face of waybills." The tariffs on the Southern Railway and Chicago & Alton Railroad provided that on washed Nc. 1 egg coal there should be deduction 1 per cent. for moisture from *actual net weight*. On four cars which moved from Lake, Ill., to Iowa points on Chicago & North Western Railway that carriers refused to make deduction as shown by billing, and collected tariff rates on net weight. Tariff effective on Chicago & North Western Railway provided that shipments received from connections accompanied by billing showing gross, tare, and net weights would be accepted without reweighing. Complainant contended that latter provision bound Chicago & North Western Railway to accept figures showing remainder after deduction for moisture *as net weight* and asked for reparation.

Alabama

Birmingham—Nothing has stirred more interest in Southern coal circles than the announcement that the Alabama, New Orleans Transportation Co. had placed an order for 50 self-propelling steel barges, 240x36 ft. in dimensions, to be used in conveying Alabama coal to New Orleans via the Warrior River, Lake Bourne Canal and Mississippi River.

Naturally, the interest is not in Alabama alone, when it is understood that this barge line will have to displace Pittsburgh, Illinois and Kentucky coals in that market if it succeeds. Raphael Brill, care Gugenheimer, Utermyer & Marshall, 37 Wall St., New York, secured the incorporation papers, and the capital stock is put at $1,087,500.

Subsidiary to and part of the general transportation company is the Alabama & New Orleans Canal Co., with capital stock of $150,000, incorporated at Detroit, Mich., with Henry Chaffe, president, George Denegree, vice-president, Alexander Allison, secretary and treasurer. This company has just bought the Lake Bourne Canal at a cost of over half a million dollars, and this canal is to be part of the navigable route of the barge line.

None of the parties interested in either of the companies mentioned are in the business of mining in Alabama, except Joseph Headley, of New York, who is largely interested in the Alabama Consolidated Coal & Iron Co., which went into the hands of a receiver a few days ago. If such is the case, the inference is that the company will devote itself to transporting coal and other freight from the coal fields and Birmingham district of Alabama. Officials of the company have thus far declined to give out the details of the plans but such as are given above are reliably certain.

Colorado

Denver—It is said that there is little prospect of the trouble between the miners and the Colorado Fuel & Iron Co. ever being settled. The explanation probably lies in the fact that the company is not in sympathy with union labor, making it a point to employ nonunion men.

The Supreme Court, in the recent case of the Consumers League of Colorado vs. the Colorado & Southern R.R., has decided that railroads engaging in the traffic of coal from northern Colorado fields to Denver must reduce the freight rate from 80 to 55c. per ton on lump coal.

Golden—A recent important addition which has been made to the equipment

of the Colorado School of Mines is a new 14-ft. Littrow spectrograph, purchased at a cost of $1500 through the Vinson-Walsh Research Fund. The instrument is located in the Department of Physics. The finely ground ore to be tested is burned in an electric arc, and the light from the flame is broken, by passing through prisms, into the colors of the spectrum. This spectrum is viewed through a powerful telescope and if any mineral is present, even in the most minute quantity, a certain line corresponding to the mineral will be seen in the spectrum.

With the present knowledge only qualitative tests can be made but to predict that before long quantitative tests can be made is not so visionary as it might seem.

Illinois

Auburn—It is understood that the Chicago & Alton R.R. is thinking of sinking more coal shafts in the vicinity of Auburn and of moving the division point now at Girard to the former place. The details of this transaction have not been made public as yet but it can be readily seen that the loss of the Northwestern coal business when their new road from Peoria and Girard is completed, would create a big hole in the Alton receipts and consequently the officials have been casting about for other business to take its place.

Girard—While engaged in drilling for artesian wells, engineers are said to have brought to the surface specimens of a fine grade of hard coal in the Schuylkill County. Upon further investigation they reported that the coal is of a superior quality and that there are at least 6,000,000 tons under the property in question.

Bloomington—Work was resumed in actual mining operations in the McLean County coal shaft this morning after a layoff of over two months because of the fire discovered in the drop pit a half mile west of the main shaft near the Union depot. A force of about 150 men reported for work. The immediate vicinity of the fire has been bricked off with a thick double wall and several alterations will have to be made in the way of a new airshaft and new tracks.

Greenfield—According to the Geological Survey, there should be no coal within five miles of the Kincaid-Marshall colliery at Greenfield, and yet coal of a high quality at a depth of only 60 ft. has been discovered. The bed is 5 ft. thick.

Hillsboro—The Peabody Coal Co. is repairing the tipple at the Kortkamp mine. The miners are expecting a call to begin work on or before July 15, after an idleness of three and a half months.

Pekin—Three hundred and fifty tons of coal belonging to the gas and electric company are burning at the Champion mine. The coal was stored on the mine grounds and caught fire from spontaneous combustion. Some of it has been saved but the intense heat has baffled the men and the biggest portion of the supply is burning out.

Trenton—A new method of coal mining is to be tried in St. Claire County, known as the stripping process. In this process the dirt lying on top of the coal beds is taken away by means of large steam shovels, and the coal is removed by means of the shovels, which will load it directly into the train.

Indiana

Indianapolis—J. P. White, president of the United Mines Workers of America, recently stated in a communication to President Garigus, of the Miners' Union, District No. 8, that he is favor of the position taken by the Indiana cagers, who maintain that eight hours constitute a day's work for the cagers, as well as for other employees in the mine, and those who work more than eight hours must be paid for overtime. The case was submitted to the president by both the miners and the operators, and the decision is final.

Terre Haute—P. H. Penna, secretary of the Indiana Coal Operators, who recently acted as umpire in a disagreement between 3000 miners in the Ohio County Kentucky coal fields, has decided in favor of the operators. The dispute had to do with the application for the increase in the relative prices per ton for pick and machine mining in that field. P. L. Lewis, former president of the United Mine Workers, decided the same question two years ago in favor of the operators.

Kansas

Frontenac—The sinking of deep wells in this vicinity for the past few years has clearly demonstrated that coal has not been mined out yet by several years. The first vein, which is found at from 30 to 40 ft. below the surface, has been worked but very little because of the fact that a safe roof could not be had for a shaft and it was too deep for stripping by the old way. The second vein, at a depth of all the way from 70 to 110 ft., has been worked the most and is the one from which Frontenac's coal supply has been coming for the past 25 years. Thousands of acres of this vein are yet to be mined in this vicinity and two or three shafts are now being sunk on virgin coal land. The lower or third vein, which is at a depth of 240 to 250 ft., has never been touched at any place in this part of the district.

Kentucky

Lexington—Examinations of applicants for the positions of assistant inspector of mines will be held at the office of C. J. Norwood, State Inspector of Mines, during the latter part of July. Inspectors for the Earlington district in western Kentucky and for the Big Sandy district are to be appointed.

Michigan

Bay City—Only 700 miners out of 1500 are said to be working in Bay County at this time. The cause of this is said to be West Virginia coal, which seems to be very much favored in this state.

Nebraska

Omaha—It is said that a good many heating furnaces in Omaha which have always heretofore burned anthracite coal will be run this winter with other grades of coal and with coke. The reason given is the monopoly which seems to exist in the anthracite coal in this section.

New York

Buffalo—The government is preparing to push its claim to ownership of North Pier at the mouth of the Buffalo River, occupied for so many years by the Delaware, Lackawanna & Western Coal Co. as its chief shipping point of anthracite to the upper lake. The company is looked upon by the government as a squatter, but it has always made good its claim to ownership in a long series of litigation lasting more than 25 years. An effort is being made to bring the case to trial when the U. S. District Court convenes in September, but it is the opinion of certain officials that a year or two will be needed to gather evidence. The company has shipped more than a million tons of anthracite over the trestle it has on this pier every season for many years.

North Dakota

Medora—Another burning coal mine has been discovered here in the lignite district. Twenty-five years ago efforts of mining lignite in this section were obstructed by fire and since the tunnels of that time were closed no sign of fire has been seen. However, when workmen reached the same depth again last week they found that the fire was still there and there appears to be no chance of checking it.

Ohio

Crooksville—The Crown Coal Mines and the Tropic Mine at Rose Farm will be put in operation this week. At the Tropic Mine extensive improvements are nearly completed. Ambrose Evans has recently succeeded W. G. Wangle as superintendent at the Crown Mine. Headquarters of this mining company are at Detroit.

Ironton—It is claimed that the new

coal company at Pine Grove will give employment to 100 or 150 men, perhaps. The side track is being built and a coal dumper for loading engines will be built on the siding. The mining will all be done by machinery. Four side tracks are being placed and 100 tons of coal can be loaded daily. A store and a large power house will be built also.

Pennsylvania

Bituminous

Charleroi—A call has been issued for a conference of the Scale Committee of District No. 5, United Mine Workers of America, with the operators, July 16, at Labor Temple in Pittsburgh. The scale provisionally adopted by the International Scale Committee at the meeting last winter will probably be discussed.

Connellsville—Borough Engineer F. B. Gibson has left with a corp of surveyors to complete the survey of the old Franklin mine, which has been closed. The State Mining Department requires that maps of all abandoned mines be made. The mine is one of the oldest in this section of the country.

Ellsworth—The first annual first-aid meet of the miners of the Ellsworth Co.'s collieries was held July 11. Over 100 trained men took part, and three mines of the company were represented.

Greensburg—A inter-company first-aid meet is to be held at Oakford Park on Aug. 17. All of the coal companies will be asked to send teams to compete and invitations have been issued to Governor Tenner, Secretary of the Interior Walter L. Fisher and to Dr. J. A. Holmes, director of the U. S. Bureau of Mines.

Anthracite

Ashland—Soon after being lowered into Boston Run Mine, after two weeks' idleness spent in an outside pasture, two big black mules, owned by the Reading Coal & Iron Co., suddenly went mad, frothing at the mouth and snapping viciously at everything within reach. They tore through the gangways, forcing the workmen to flee for their lives. The animals were finally shot.

Mahanoy City—Laborers completing a tunnel which requires six weeks to be driven, discovered the Buck Mountain vein 9½ ft. thick at the Middleport mine.

Pottsville—The famous barrier pillar case in which Mine Inspector John Curran, has claimed that barrier pillars between the collieries of the Dodson Coal Co. and the Mill Creek Coal Co. should be maintained at 300 ft. to protect the miners from the waters of subterranean lakes, has finally been decided in Curran's favor.

Scranton—The surface on South Main Ave., between Hampton and Lucerne Sts., still continues to settle. The Gas & Water Co. is having considerable trouble with its water main. Nearly every joint in the main line is leaking.

The Delaware, Lackawanna & Western Coal Co. today announced that hereafter it would repair damage done by its mine cave-ins. Where the company proposes to rob pillars it will notify the surface residents to move out and supply them with a temporary home. When the coal is taken out and the surface has settled the houses that are about to topple will be set plumb and any damages to the building will be repaired.

John T. White, president of the United Mine Workers of America, is to preside when three hundred delegates of District No. 1 convene in Scranton. President White comes to the anthracite region in a membership campaign and is expected to swell the ranks of the union to unprecedented totals. It is unofficially reported that a move will be launched early in the convention to change the tenure of office in the district from one to two years and make the district meeting a biennial affair.

Shamokin—Relays of rescuers in the Burnside mine of the Philadelphia & Reading Coal & Iron Co., worked hard to reach two miners who had been entombed for several days. A portion of the roof has caved in, inclosing the two men where they had been at work. The rescuing party reached the entry in which they expected to find the missing men, but they were not there. Finally, it was believed that the men were in a higher cross-section and the work of rescue was directed accordingly. The men were at last found pinned under coal and slate. They had been dead a long time.

Wilkes-Barre—Chief Engineer Bunting, of the Lehigh & Wilkes-Barre Coal Co., after a careful investigation, has declared that coal is not being mined within several hundred feet of the surface in the vicinity of school buildings and consequently the schools in the vicinity of Wilkes-Barre are not in danger.

Texas

Loving—A 5-ft. bed of coal has been struck at a depth of 110 ft. which has been declared to be the best quality of coal in the state. Machinery has been ordered and it is expected that mining operations will begin by the first of September.

Virginia

Richmond—Six miners were instantly killed and three others seriously injured in an explosion at the Gayton coal mines, owned by the Old Dominion Development Co., on July 16.

Washington

***Spokane, Wash.*—The Sand Coulee Coal Co., of Great Falls, Mont., which has been engaged for 18 months in developing a new mine at Sand Coulee, has put in a 1000-ft. tunnel, and has already begun marketing coal. The great Northern R.R. has completed an 1850-ft. side track from the Stockett Sand Coulee branch of that system to the newly opened mine.**

Tacoma—The Northern Pacific R.R. is preparing to test the best coal for steaming purposes and has provided a car of instruction at the Tacoma roundhouse where lectures are given to firemen and engineers on the economy of fuel.

West Virginia

Gilmer—The first meeting of the directors of the Gilmer Consolidated Coal Co. recently incorporated in this state was held on the 10th of July. The following officers were elected: Lewis Bennett, president; W. G. Colburn, vice-president; F. E. Brackett, secretary and treasurer.

This company will absorb several small operating companies in the vicinity of Gilmer where they have acquired a large acreage and will have, after the proposed development, the large tonnage of the well-known Copen-splint coal. They propose to install a large power station together with miners' houses and stores. The Davis Colliery Co. have an operation in this same field known as Bower Mine No. 10.

Moundsville—An explosion which killed eight men and injured several others occurred in the shaft of the Panama mine of the Ben Franklin Coal Co. on July 11. Conditions were made worse by a fire which followed the explosion. It is thought that the explosion was due to ignition of gas from a charge of blasting powder.

Wyoming

Cheyenne—The Wyoming State Federation of Labor calls a meeting in Cheyenne on July 8, and after the convention the District Convention of Mine Workers met.

Chile

Santiago—The premature explosion of a dynamite blast at the mines of the Braden Copper Co., July 8, resulted in the death of 20 miners.

England

Barnsley, Yorkshire—Two men were killed outright and 12 others injured on July 6 by an explosion which wrecked a portion of the main colliery of the Barnsley mine.

Personals

I. J. Broman, chief mine inspector of Texas, has gone to Birmingham, where he will spend several days inspecting the coal mines and other industries.

J. H. Wheelwright, president of the Consolidation Coal Co., has been inspecting the properties of the consolidation in West Virginia and Kentucky during the past week.

J. P. White, president of the United Mine Workers of America, spent a few days in Peoria, Ill., while on his way to Indianapolis, the national headquarters of that organization.

John Morris, mine foreman of the Prospect colliery of the Lehigh Valley Coal Co., of Plains, Penn., has resigned his position to assume charge of the Aldine Coal Co. property.

Thomas Graham, chief mine inspector, Victoria, B. C., Canada, is on a trip of inspection through the United States and at present is in Springleld, Ill., looking at the Sangamon County shafts.

P. E. Womelsdorff, who has been a mining engineer in the central Pennsylvania coal region for the past 30 years, has just returned from an examination of coal lands in Colorado and Wyoming.

E. P. Erckenbach, formerly traveling freight agent for the Great Northern, Seattle, has recently gone to Spokane, Wash., to take a position as sales agent for the Crows' Nest Pass Coal Co., Ltd.

W. J. Hoynes, inventor of a new safety mining powder, is now experimenting in coal mines at Earlington, Ky., in company with James Epperson, formerly state mine inspector for Indiana. Hoynesite, as the new powder has been called, will be tested thoroughly.

E. H. Coxe, of Birmingham, Ala., former general superintendent of coal mines and coke ovens for the Tennessee Coal, Iron & R.R. Co., is taking a two or three weeks' trip through the coal field on the Norfolk & Western R.R. in Virginia and West Virginia.

E. C. Roberts, Jr., has been appointed resident manager of the Fairmount Coal Co. to take the place of J. A. Beam, who has resigned to take up the management of his oil and gas property. Mr. Roberts has been for some time with the Ellsworth Collieries Co., which is owned by the Lackawanna Steel Co.

T. V. Salt, who for the last three years has been superintendent of the byproduct coke-oven plant of the Illinois Steel Co., at Joilet, has resigned his position, to take effect July 1. The Inland Steel Co., of Indiana Harbor, has contracted with him to build for them a first-class byproduct coke plant. The type of oven has not as yet been decided on, but in all probability it will be the Koppers direct prcoess.

Publications Received

POWER HOUSE DESIGN. By John F. C. Snell. 448 pp., 6x9 in. 17 plts. 186 illus.; cloth. $6. Longmans, Green & Co., New York.

For a number of reasons not hard to understand, the generation of power at a large majority of coal mining operations has never been deemed a matter of sufficient importance to warrant any great effort to secure the best attainable economy. And indeed, the careless design, crude equipment, and inefficient working of colliery power plants have from time to time elicited no small amount of adverse criticism.

But the modern tendency toward centralization of power supply, the steadily increasing commercial demand for the smaller sizes and lower grades of fuel, and a growing realization that the cost of power is often needlessly high are factors which are all working toward the installation of plants of a kind which compares well with types that have been evolved in other fields of industry under the exigencies of higher costs for fuel and labor.

Although Mr. Snell's treatise on power-house design deals largely with plants of a size and type beyond the scope of the average mine equipment, the data and principles set forth apply broadly to all power plant installations and can scarcely fail to be of service in the design of any plant intended for the generation of steam and electric energy.

American readers of this book will doubtless be inclined to deplore the fact that its many valuable items of cost data are stated exclusively in terms of pounds, shillings and pence, and they will recognize as being distinctly alien, certain forms of boilers, engines and other details of equipment that are discussed. But the work is decidedly comprehensive in its scope and embodies, for the most part, what may be taken as standard modern practice, regardless of national preferences and local tendencies.

The author states that he has aimed to select and compile in one volume all the practical information required for the design of a modern power plant, bringing to this work an experience extending over 20 years, and this claim is consistently justified throughout the extent of the text. While Mr. Snell disclaims having introduced any great amount of original matter, the book is far more than a mere compilation and classification of existing data; there is everywhere evident the personal judgment of an engineer of broad experience and it is this expert knowledge which has been exercised in the selection and presentation of the subject matter, that makes the work particularly valuable.

Power plant buildings, steam raising equipment, piping, condensers, etc., are dealt with in considerable detail and a large amount of valuable reference data is clearly and concisely presented. The chapter on steam operated generators consists chiefly of a discussion of the several types of steam turbines, but it aims to emphasize the points which must be taken into consideration in the selection of any prime mover for electric generating apparatus, whether of the reciprocating or turbine type.

Internal combustion engines are dealt with at some length and also plants for the generation of gas power. Switchboard equipment and practical notes on the selection and installation of electrical machinery are accorded due consideration, as is also the general design of hydro-electric plants. As previously intimated, the small power plant is somewhat neglected, except inasmuch as a great portion of the text applies to all power-house installations regardless of size. The drawings and illustrations are clear and effective and the publishers are to be complimented on the typographical excellence of the work.

Construction News

Indiana, Penn.—The contracting firm of Heyl & Patterson, of Pittsburgh, are building for the Rochester & Pittsburgh Coal & Iron Co. a large coal tipple of steel and concrete construction at Gatesboro, near the Indiana County line in Armstrong County.

Edmonton, Alberta, Canada—The Roberts-Schaefer Co., of Chicago, is preparing plans for the equipment of and installation of machinery on the Security Coal Mines Co. mine at Walbumen, Alberta. W. C. Dunn is general manager for the Security Coal Mines Co.

Brookville, Penn.—A corporation which is now applying for a charter under the name of the Knoxdale Coal & Coke Co. has purchased 150 acres of coal land near Knoxdale, and this line is now being opened. A switch and tipple are under construction and are rapidly nearing completion.

Columbus, Ohio—Another short railroad is to be built in the Big Sandy Valley to tap the mineral wealth of the Kentucky Mountains. Articles have been filed with the Secretary of State incorporating the Knox Creek R.R. Co. to construct a line nine miles long in the Kentucky and Virginia line near the mouth of Knox Creek Valley.

Barnesboro, Penn.—The Clearfield Bituminous Coal Corporation is erecting a new power house and making numerous other improvements at their West Branch Mine. Two 250-kw. alternating-current generators direct-connected to two Balwood Cross compounding non-condensing Corliss engines are to be installed to generate current at 4100 volts.

Fairpoint, Ohio—The largest single piece of construction work ever undertaken in Belmont County is the new mine of the Provident Coal Co. The contract calls for an expenditure of $350,000, but it is expected that it will cost fully $500,000 before it is completed. The mine will give employment to 500 men, and is a subsidiary of the Pickands-Mather Corporation of Cleveland.

Coal Trade Reviews

Current Prices of Coal and Coke and Market Conditions in the Important Centers

General Review

The general coal market is probably in the most unique and unusual position in the history of the coal industry. The bituminous trade, normally quite dull at this period of the year, is down to even a lower point than usual, while, on the other hand, there is such an acute shortage of anthracite that the outlook in this branch is regarded as quite ominous.

In general the Eastern hard-coal situation is characterized by an insistent demand, and a short supply, while disappointment is expressed on every hand at the small arrivals. Dealers are continually getting further behind on orders, and it is difficult to see how they will be able to handle the heavy fall and winter demand; premiums are being freely offered at a number of points. The movements to the Northwest are reported as quite heavy, and it is becoming apparent that the operators are proportioning shipments in favor of the most remote points.

Soft-coal in the Eastern market has reached the lowest price level, experienced for some time, and there is no improvement in sight; production is evidently being rigorously curtailed, but the demand is so slack that even the small arrivals are being disposed of with difficulty. Many of the consumers are refusing to renew contracts because of the prevailing low prices in the spot market, but, on the other hand, stocks are undoubtedly being rapidly depleted, and they will be compelled to enter the market soon.

There is a slight evidence of increased trade at some point, and with the activity in steel, and the stiff coke market, it is not at all improbable that the dull summer trade may wind up with a strong market in the fall. A better volume of business in both steam and domestic is reported in Ohio, and the Lake trade continues quite active with indications good for a heavy movement this season. At Hampton Road the past week's loading has been quite satisfactory, and there are smaller accumulations at the piers than at any time during the past six weeks.

A heavy congestion is reported at the upper lake docks, vessels often finding it necessary to make two or more piers before sufficient unloading accommodations can be obtained; the market at that point is reviving, and prices have materially improved.

There is no apparent change in the Middle Western situation, although business appears to be opening up somewhat stronger, and indications are good for an active fall trade. Prices still continue at the low level prevailing there for the past few weeks, but a shortage in some grades has developed, particularly West Virginia smokeless.

Boston, Mass.

Anthracite and bituminous are certainly at opposites in this market. For the former there is an insistent demand and an ominously short supply, while in soft coal, prices are at the lowest level, and no improvement is in sight. On Pocahontas and New River there is only a small tonnage moving, and almost none on spot business. In a normal market the trouble with marine firemen on steamers and tugs would be serious, but just now with the surplus of tonnage it is scarcely noticed, so far as concerns the freighting coal. Georges Creek and the Pennsylvania coals show no change, and bituminous all over is extremely slow.

Anthracite is still coming to tide in disappointing quantities, and there are again rumors of small premiums offered for shipments of stove coal. That is generally the size most in demand, but the shortage is by no means confined to that grade. All the dealers on the coast are way behind on receipts, and it is hard to see how they can catch up before the usual extra fall demand sets in.

Wholesale quotations are about as follows:

Clearfields, f.o.b. mine	$1.05@1.30
Somersets f.o.b. mine	1.10@1.35
Somersets, f.o.b. Philadelphia	2.35@2.60
Pocahontas, New River f.o.b. Hampton Roads	2.50@2.60
Pocahontas, New River on cars Boston	3.40@3.50
Pocahontas, New River on cars Providence	3.30@3.40
Anthracite stove f.o.b. New York	5.00@5.25

New York

Bituminous—The New York bituminous market is probably at a lower point this season than at the same time for a number of years. Even during this customary dull period, there is usually some evidence of spot business, but such is entirely lacking at the present time.

There is, however, a noticeable optimism on the part of some of the large companies, in spite of the apparent depressed condition of the general market. These companies point to the fact that there is no coal on demurrage, stocks at South Amboy are about normal, and there is more or less contracting being done. These same concerns firmly believe that there will be a strong and active market during the coming fall and winter.

There are no sales being recorded by which to quote the present market, but we continue the following prices which are doubtless being shaded:

West Virginia, steam	$2.35
Ordinary grades, Pennsylvania	2.45
Fair grades, Pennsylvania	2.55@2.65
Good grades, Pennsylvania	2.70@2.75
Best Miller, Pennsylvania	2.95@3.00
Georges Creek	3.15

Anthracite—Arrivals of hard coal still continue far below normal for this period, and the prospects of acquiring adequate supplies before the fall and winter activity, now appear practically hopeless. At some of the adjoining points the small consumer is obliged to make his purchases by the sack and on the whole the general aspect is considered quite serious by the large operating companies.

While the producers are said to be making every effort to obtain record tonnages, arrivals here still remain far below requirements, and probably only about 80 to 85 per cent. normal. This is ascribed to several causes, an inadequate supply of labor at the mines, and the diverting of large shipments to points more inaccessible during the severe winter months.

The New York anthracite quotations continue about as follows, those for the Lackawanna and Wyoming being at the upper ports, and the Lehigh and Schuylkill for the lower:

	L.&W.	L.&S.
Broken	$4.80	$4.75
Egg and stove	5.05	5.00
Chestnut	5.20	5.15
Pea	3.50	3.45
Buckwheat	2.75	2.45
Rice	2.25	1.95
Barley	1.75	1.70

Pittsburgh

Bituminous—The local coal market continues quiet, with demand hardly up to normal for the season; domestic is entirely stagnant. Demand from iron and steel mills and factories in kindred lines is good for the summer period, but somewhat light at the moment on account of closings for repairs. Prices are but indifferently maintained, slack in particular being a drug on the market, and even 50c. is sometimes shaded. The Lake coal movement continues good, but on the whole is hardly up to the early expectations. We quote as approximate market prices: Nut, $1.10; mine-run, $1.15; ¾-

in., $1.25; 1¼-in., $1.35; slack, 50@75c. per ton at mine, Pittsburgh district.

Connellsville Coke—The furnaces have not yielded to the demands of operators in the matter of contracts for second half, and the latter are avoiding the making of contracts by picking up coke for prompt shipment. Purchases of a round tonnage in the aggregate have been made in the past week at from $2 to $2.50, but it is claimed that practically all the coke which went at under $2.50 is off grade, and some of it badly so; the furnaces, however, are willing to inconvenience themselves rather than pay the price demanded by the operators who have been holding together, for $2.50 for either prompt or contract. We quote: Prompt furnace, $2.40@2.50; contract furnace (asking price) $2.50; prompt foundry, $2.40@2.50; contract foundry, $2.40@2.75.

The *Courier* reports production in the Connellsville and lower Connellsville region in the week ending July 6 at 329,161 tons, a decrease of 65,000 tons, and shipments at 9777 cars, a decrease of 2300.

Philadelphia, Penn.

The coal trade in the anthracite branch still continues in a satisfactory condition. Much fear was felt about the middle of June that late in July and during August the usual slump that takes place in the market for this grade of coal would occur, but operators have nothing but good to say of the trade, and declare that business prospects look splendid from now on until cold weather sets in, and after that, the natural demand will make it almost impossible to fill the dealers' requirements.

Locally the trade is not in a particularly rushed condition, but the wholesale market could not be improved upon. It is true some coal is going into stock, but this is the small sizes only. There seems to be a shortage of stove coal in the local market, due no doubt, to the excessive demand for this size at tidewater. It is also understood that large quantities are now going to the Lakes for transshipment to the Northwest, and this has the effect of making certain sizes short in this market. All the mines are working full time, and it is expected that this condition will last all through the summer. As a matter of fact, no falling off in the demand is looked for much before early in the spring of next year, if present indications hold out.

Compared with this time last month, the bituminous trade looks even worse. It is understood that the production at many of the mines is being curtailed, and the demand is slack for even the small quantity that is going to the market. Coal caught on demurrage at tidewater points is being sold at less than the cost of production, and wise shippers are waiting until their orders are well in hand before loading. Cases have been noted where first shipments from the mines for a consignee have gone on demurrage before the final shipment is completed, indicating very cautious deliveries by producing companies.

Baltimore, Md.

A feature of interest to the Baltimore trade is the statement of a number of the large operators that the stocks of many of the heaviest consumers are being fast depleted, and that they will be compelled to enter the market within the next two or three weeks. An official of one of the large operating companies here stated that he had visited a dozen of the big consumers and found their stocks were getting exceeding low

These consumers, however, will not close any contracts, as they believe that better prices can be obtained for some time to come in the spot market. It has been a surprise that so many consumers, who have heretofore signed up with local companies under contract, declined to renew these as usual this spring. They declare that they prefer to take their chances on the spot market.

Operators agree that spot business has been lower than contract prices, but contend that, even though the market may continue inactive for weeks longer, prices will not get any lower. It is pointed out that many of the local operators reaped a harvest while the strike in England was at its height, and that these profits were sufficient to tide them over a long dull period.

Several of the Baltimore operators bid on the 20,000 tons of coal required by the Government Hospital for the Insane, and it is not unlikely that one of the local companies will procure the contract.

Officials of the Davis Coal & Coke Co. have made arrangements for delivering coal under the twenty-year contract which it has with the Bethlehem Steel Co., and it is said that the first shipment has already been forwarded.

Buffalo, N. Y.

There is some improvement in the bituminous trade, mostly in quantity, but with prices at least as good as formerly. While the reports of better trade are not general they seem to be on the increase and with the activity in steel and the stiffness of coke it may develop that the last part of the slack summer season will be better than the first. Buffalo at least is, industrially, very active and the factories that laid in such heavy supplies in March against a possible strike are now about all back in the buying list.

There is not, as a rule, the improvement in the bituminous market that would be expected from the activity in steel, but that is on account of the very low condition of the market when steel began to stir. So many mines are running on part time or not at all that it is going to take some time to get coal into line, especially with certain large operators and jobbers failing to see any improvement at all as yet.

There is no change in the quotations of bituminous, the regular Pittsburgh figures for this market holding weakly at $2.57½ for three-quarter, $2.47½ for mine-run and $2 for slack. Coke is strong at $4.50 for best Connellsville foundry, with stock coke very hard to get. There is a fair market for side coals, smithing of various grades holding up well.

The anthracite situation is becoming still more strained if possible, the shippers as a rule not filling their orders completely, but piecing out here and there the scant supply that comes in from the mines. Lake shipments for the week improved a little, being 128,000 tons, though that is not up to the average for recent seasons. Leading shippers say frankly that they do not expect to be able to satisfy the present heavy demand before the regular rush takes place in the fall.

Cleveland, Ohio

There has not been any improvement in this market in the past week; in fact, if anything, it is worse than during the past two weeks. The small amount of coarse coal, shipped to this market, has gone begging, and in some cases was offered for the freight in order to get rid of it and save car service. Slack is also a very slow, selling as low as $1.30 for No. 8.

Lake trade is also dull, there being a large amount of coal on tracks here, and at other Lake Erie ports awaiting loading. On account of the congestion on the upper lake docks, there is little room to unload, and boats have to make several docks to get rid of coal cargoes. There will be no improvement at the unloading ports until coal moves faster to the interior.

Columbus, Ohio

A better volume of business in both the steam and domestic departments and a continuation of activity in the Lake trade were the chief features in the Ohio trade during the past week. The tone of the market is good and operators as well as jobbers believe that prices on all grades will be advanced about Aug. 1.

One of the best features of the trade is the signs of awakening in domestic circles. Dealers are now placing orders with the operators for all domestic grades. Manufacturing establishments

are also taking a larger tonnage for steam purposes. The stocks stored up before Apr. 1 in anticipation of a suspension are now about exhausted and steam users are placing larger orders.

Lake trade is continuing active and the indications are good for a large tonnage this season. The situation on the docks is satisfactory and the little flurry caused by the decrease of 10c. on the ton has now been discounted. Chartering of boats is going on steadily and the ore business is holding up well. Prices are strong in almost every branch, although some weakness is apparent in the fine sizes, which is due to the large Lake tonnage; that invariably happens at this time and is not a sign of weakening prices.

Production has been pretty active in the various mining districts of the state during the past week. The tonnage shipped from the Hocking Valley and Pomeroy Bend was large, and a larger production is also reported from eastern Ohio.

The quotations in Ohio fields are:

Hocking Valley	
Domestic lump	$1.50
¾-in	1.35
Nut	1.10
Mine-run	1.15
Nut, pea and slack	0.55
Coarse slack	0.40
Pittsburgh No. 8	
¾-in	$1.10
Mine-run	1.00
Coarse slack	0.45
Pomeroy Bend	
Domestic lump	$1.50
¾-in	1.25
Nut	1.20
Mine-run	1.10
Nut, pea and slack	0.50
Coarse slack	0.45
Kanawha	
Domestic lump	$1.50
¾-in	1.30
Mine-run	1.20
Nut, pea and slack	0.45
Coarse slack	0.35

Hampton Roads, Va.

The past week's loading at Hampton Roads was quite satisfactory—the market having recovered perceptibly from the slump of the previous week. There is a good demand for local coal, much of it being reported on spot orders; it is evident that some of this coal was sold as low as $2.50 f.o.b. Hampton Roads, although it is difficult to confirm reports of such sales. There is a smaller accumulation of coal here now than there has been for six weeks. The curtailment of shipments at the mines earlier in the month, together with a substantial dumping here during the past week, has reduced the coal on hand to a more normal supply.

A few coastwise vessels were delayed here on account of the seamen's strike and for a while it looked as if trouble might be expected. However, adjustments were promptly made and it does not appear that the strike is of enough consequence to affect the coal business. Of unusual interest is the presence of the steamers "Hermod" and "Maude" at the Norfolk & Western piers for full cargoes of coke. Both steamers are destined to Tampico. It has been a long time since two steamers have called at Hampton Roads at the same time for full cargoes of coke.

Detroit, Mich.

Bituminous—The market here is reviving quite materially, and prices are beginning to show a great improvement. There are a few large contracts being closed on a basis of $1 per ton f.o.b. mines from West Virginia. However, there still seems to be an abundance of fuel arriving, and two-thirds of the consumers are well stocked. The condition is very peculiar, as there is lots of coal on hand, and prices advancing.

There are little or no cargoes of fuel for points in the Lower Peninsula. Several vessels are waiting at Cleveland but cannot get cargoes. All the large dealers are storing to their utmost capacity for domestic purposes.

West Virginia lump is quoted at $1.20, three-quarter $1.05, mine-run at 95c., nut, pea and slack 75c. Cambridge three-quarter lump is $1.10, mine-run $1, slack at 70c. Pocahontas lump is $2, mine-run $1.10, slack 90c., while Jackson lump is $2.50 f.o.b. mines. All are unanimous that the prices will advance to 50c. a ton over and above the present quotations within the next six or eight weeks.

Anthracite—The market on anthracite at the present time is very firm. It is now becoming scarce, and it is entirely out of the question to place an order for any amount. The price on grate, egg and stove is $7.50, chestnut $7.75, pea at $5.75, buckwheat at $4.50 per gross ton f.o.b. Detroit.

Coke—Connellsville coke is very scarce here at the present time. If this continues it will create a famine in this product. The quotations are $5.15 on Connellsville and $5 on Solvay, f.o.b., Detroit.

St. Louis, Mo.

There is practically no change in the St. Louis coal market, with the exception of an increase in the price of Carterville washed coals, and a brisk demand for anthracite, smokeless and coke. A call for anthracite and coke, such as the dealers are receiving right now, usually precedes a general demand for the cheaper coals, and indications are that several of the dealers who have closed up for the summer will from this time continue to open up for the season's business.

There is a decided scarcity of anthracite in this market, with the result that the retailers are endeavoring to switch this business to smokeless, and as a rule they are meeting with considerable success. The St. Louis market has picked up considerably in the last week.

The prevailing prices are:

Franklin County	
6-in. lump and 3x6 egg	$1.35@1.50
Nut	1.35@1.50
No. 2 nut	1.25@1.35
Screenings	0.90@1.00
Carterville	
6-in. lump and 3x6 egg	$1.20@1.35
Nut	1.15@1.25
Screenings	0.90@1.00
Mine-run	1.05@1.10
Washed No. 1	1.75
Washed No. 2	1.50
Washed No. 3	1.30
Washed No. 4	1.00
Washed No. 5	0.85
Mount Olive	
Lump	$1.15@1.25
Nut	1.00@1.10
Screenings	0.90@0.95
Standard	
2-in. lump	$0.85@0.95
6-in. lump	0.90@1.00
Screenings	0.65@0.70
Mine-run	0.85@0.90
Anthracite	
Chestnut	$7.25
Egg and stove	7.00
Grate	6.75
New River and Pocahontas	
Lump	$4.50
Egg	4.40
Gas House Coke	4.50@4.60
By product coke	4.60

Chicago

Chicago dealers in anthracite believe it will be a scarce commodity this year At the present time orders for small amounts cannot be placed with any certainty that there will be speedy delivery and as a result the buying movement has been accelerated.

Comparatively little steam lump is being used in the Chicago trade, preference being given either to screenings or mine-run coal; the latter remains at just about the price established immediately after the mine suspension. It is very difficult to obtain smokeless lump and egg coal, as most of the producing concerns are sold up to Sept. 1. An unusually heavy volume of business in byproduct and gas-house coke is reported, but recent price advances have had no effect upon sales. Prices for screenings remain firm.

Prevailing prices at Chicago are:

Sullivan County	
4-in. lump	$2.47
Egg	2.37
Mine run	1.99½
Screenings	1.72@1.82
Springfield	
Domestic lump	$2.32
Steam lump	1.97
Mine-run	1.82
Screenings	1.62@1.72
Clinton	
Domestic lump	$2.27
Steam lump	2.12
Mine-run	1.92
Screenings	1.67@1.72
Pocahontas and New River	
Mine-run	$3.15
Lump and egg	3.95@4.05

Coke—Prices asked for coke are: Connellsville, $5@5.10; Wise County, $4.85@5; byproduct, egg and stove, $4.75; byproduct, nut, $4.55; gas house, $4.50.

Portland, Ore.

There is no change in the situation here and the market for coal is naturally quiet at this time of the year. Shipments from Wyoming and Washington are about the average and no reports have been announced here to the effect that any coal is coming from Australia for some time at least. No vessels have yet been chartered for such business unless the transaction has been kept quiet, which is not likely. There is yet enough Australian coal on hand to last some time. The storage price list has not been announced yet and it now seems as if there will be no material reduction during the summer.

Production and Transportation Statistics

The Car Situation

For the fifth consecutive time, the members of the American Railway Association have reported a decrease in the number of idle cars. For the fortnight ended July 4 the net surplus of cars on all lines in this country and Canada stood at 64,024, a decrease of 3694 in the two weeks. On Apr. 25 last there were 138,881 cars not in use.

While the aggregate of all classes of cars was reduced, the surplus of box cars increased during the fortnight from 26,606 to 29,662. The coal-car surplus decreased from 19,319 to 13,242. Miscellaneous and flat-car surpluses changed but little. While the coal surplus shows a continued shrinkage in this last report, the decrease is not as large as has been reported in the figures of the association for the past two months.

The following table shows the surplus and shortages of cars on 170 roads on July 4:

	Surplus	Short	Net Surplus
Box	29,662	3,461	26,201
Flat	3,038	1,856	1,182
Coal, gond. and hopper	13,242	1,036	12,206
Other kinds	24,789	354	24,435
Total	70,731	6,707	64,024

Imports

Imports of coal into the United States for May of the current year amounted to 132,959 tons, as compared with 95,769 tons for the same month last year. For the 11 months ending with May of this year, the total imports were 1,167,147 tons, as compared with 1,685,949 tons for the same period last year, showing a decided falling off in this branch during the current year.

Southwestern Tonnage

The Southwestern Interstate Coal Operators' Association has issued the following comparative statement of tonnage for April:

State	1911	1912	Increase or Decrease
Missouri	177,543	189,751	+ 12,208
Kansas	357,649	303,216	— 54,433
Arkansas	85,549	95,994	+ 10,445
Oklahoma	128,430	164,270	+ 35,840
Totals	749,171	753,231	+ 4,060

Baltimore & Ohio R.R.

The following is a statement of the coal and coke tonnage moved over the B. & O. and affiliated lines during the month of May, 1912, as compared with the corresponding month of the previous year:

	1911	1912
Coal	2,421,312	2,786,580
Coke	293,182	439,631
Total	2,714,494	3,226,211

The Virginian Ry.

Total shipments of coal over this road for May of the current year were 311,247 tons as compared with 280,995 for the month previous.

Foreign Markets

Spanish Imports

The following is a comparative statement of fuel imports into Spain for the 4 months ended April, 1911 and 1912:

	1911	1912
Coal	706,990	664,733
Coke	112,563	137,159

Oriental Markets

Japan—This market is very weak and lifeless as is only to be expected at this time of the year and there is little or no inquiry for forward business. Arrivals during the fortnight have been fairly heavy but it is composed mostly of contract cargo. In Japan the market is firm and stocks at shipping ports are decreasing.

Manchurian Coal—A couple of cargoes are expected to arrive shortly in fulfillment of contracts.

Coal under contract is being delivered with regularity but not much new business has been transacted. Prices remain the same and freights continue higher than usual.

German Empire

The production, imports and exports of the German Empire for the month of May, 1912, were, in metric tons:

	Production	Imports	Exports
Coal	14,734,098	882,846	2,480,522
Lignite	6,442,672	503,825	4,172
Coke	2,378,226	48,767	512,026
Briquettes	1,827,646	10,771	230,991

Great Britain

The tone of the coal market is, if anything, a shade steadier and inquiries are more plentiful. Prices are approximately as follows:

Best Welsh steam coal	$4.14
Seconds	3.84
Thirds	3.60
Best dry coals	4.08
Best Monmouthshire	3.60
Seconds	3.48
Best Cardiff small coal	2.58
Seconds	2.46

The prices for Cardiff coals are f.o.b. Cardiff, Penarth, or Barry, while those for Monmouthshire descriptions are f.o.b. Newport; both exclusive of wharfage, and for cash in 30 days, less 2½ per cent.

Financial Notes

Reading Co.—This company, in 1901, acquired $14,504,000 of Jersey Central stock at 160. At the high record price of 382 this stock shows a paper profit of $32,198,800, equivalent to 45% of the $70,000,000 Reading common outstanding at the present time.

The Superior Coal Co. of New York City—In the suit of the trustee (Knickerbocker Trust Co., of New York) to foreclose the mortgage, the amount outstanding being $1,930,000, with interest from Nov. 1, 1911, Niles B. Hersloff was, on May 18, appointed receiver. It is stated this property includes 8800 acres of coal land and 4000 acres of mineral rights.

Pond Creek Coal Co.—This company has an authorized capital of 200,000 shares, of which 150,000 shares are issued. The property is located in Pike County, Ky., where 2388 acres are owned in fee, together with the mineral rights to 26,265 acres. It is estimated that the company's property contains 200,000,000 tons of coal, and it is expected to start shipments Jan. 1, next.

Beach Creek Coal & Coke Co.—The Knickerbocker Trust Co., of New York, holds the sum of $75,300 provided for in the mortgage of the Beach Creek Co., which is applicable for the purchase of first mortgage 5% 40-year sinking-fund gold bonds of the Beach Creek Coal & Coke Co., secured by said mortgage. Offerings of these bonds will be considered at not exceeding par and accrued interest.

Nova Scotia Steel & Coal Co., Ltd.—Since Dec. 31 this company has sold $1,040,000 treasury bonds in London. The company spent during last year $1,101,145 upon buildings, plants and equipment at New Glasgow, Sidney Mines and Wabana. This amount (less credits including $102,413 received from sale of the 12½ miles Ferrona Railway to the Intercolonial Railway) has been added to the property and mine's account. The company is now spending $500,000 on a new hydraulic forging plant and fluid steel compression plant.

Wheeling & Lake Erie—This company's report for April of this year shows a decrease of 44% in gross as compared with March, and a decrease of 29% as compared with April, 1911. Decrease was due entirely to the falling off in coal traffic, general freight and passenger earnings having increased. In the face of this large decrease in gross in April, the management found it possible to decrease operating expenses only 0.06%, with the result that net amounted to $15,139, a decrease of $130,000, or 89.58%, as compared with the corresponding mont . last year.

Consolidated Fuel Co.—The United States Smelting, Refining & Mining Co. paid $1,200,000 for control of the Consolidated Fuel Co.'s properties, comprising 5000 acres in Emery County, together with the Hiawatha townsite and a half interest in the Southern Utah Railroad connecting the mine with the Rio Grande R.R. at Price. Eight hundred thousand of the 1,500,000 shares were purchased at $1.50 per share. This mine is considered one of the greatest bituminous coal properties in the West, producing 2200 tons daily, which will be increased to 3000 tons, commencing Oct. 1 of the present year.

Throwing The Searchlight On Advertising

Little Talks on a Big Subject for Coal Age Readers

By the Ad. Editor

Along the lines of what we have been saying on this page, here's an item from the July 11th *Printer's Ink* that will interest you:-

Denver Merchants to Stop Misleading Advertising

The Denver Retail Merchants' Association has appointed a committee to take steps toward the passage of a State law which will regulate to an appreciable extent fire, bankrupt and other misleading advertisements which have been appearing in local newspapers. The new law will be made to include local advertisers as well as itinerant vendors.

"But," you ask, "what has this to do with coal mining"?

Well, the answer to that is that advertising today is a national—even an international—force. It has no limits as to trade or profession. Its principles are the same in all lines and those principles stand for truth and honesty.

If the advertiser is so small that he believes he can reap a profit from dishonest advertising, then the law is going to step in and stop him.

But there are mighty few advertisers these days who need *legal* restraint—

It isn't because it's against the law in so many states that they refrain from making untrue claims and statements—

It's primarily because they are good business men and they realize that in advertising honesty is not only the *best* policy, but the *only* possible policy that can win.

And when you get business men on that basis you've got a protection and an assurance of the quality-you-want that's got all other forms of "guarantees" beaten as far as the Yankees beat the rest of the world at the recent walk-over in Stockholm.

And you must admit that's going some.

There are a lot of interesting ads in this issue—have you looked them over?

It pays to advertise only because it pays to buy advertised goods